

**Paranoia and the Role of Contingency in the Experience of
Trust and Perceived Empathy in Interpersonal Encounters**

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Thesis declaration form

I confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Overview

This thesis addresses the interpersonal determinants of paranoid ideation. Part one presents a systematic review of the empirical literature on the relationship between childhood adversity and paranoia. It considers whether there is an association between direct experience of interpersonal adversity and paranoia, and whether paranoia is specifically associated with a type of early interpersonal adversity. The data suggest that there is inconclusive evidence of a relationship, but support was found for a more consistent association between paranoia and emotional abuse. Possible mechanisms are considered, and results are discussed in the context of methodological limitations and the need for further investigations in this area.

Part two reports on an empirical virtual reality study investigating the role of paranoia and interpersonal contingency in the experience of trust and perceived empathy in encounters with unfamiliar others, and exploring associations with other factors, including attachment history and anxiety. Sixty-one healthy male participants with varying levels of trait paranoia interviewed a virtual flatmate whose non-verbal responses were either contingent, or non-contingent in relation to them. Evidence was found for an interaction between interpersonal contingency and trait paranoia in influencing explicit trust of the avatar, but not implicit trust (as assessed by distance kept from the avatar) or perceived avatar empathy. Those high in paranoia perceived the contingent avatar as more trustworthy, whereas there was evidence of greater trust towards the non-contingent avatar in those low in paranoia. Dismissive attachment predicted greater explicit trust and perceived empathy, but reduced implicit trust.

Part three is a critical appraisal of the empirical research, including personal reflections on the research process. It considers the challenges of recruitment across the paranoia continuum and the use of virtual reality technology in research investigating interpersonal encounters.

Table of Contents

List of Tables	6
List of Figures	7
Acknowledgements	8
Part 1: Literature Review	9
Abstract	10
1. Introduction	11
1.1 <i>Childhood adversity and psychosis</i>	11
1.2 <i>Research specificity: a symptom-level approach</i>	12
1.3 <i>The role of adversity in current theoretical models of paranoia</i>	14
1.4 <i>Previous consideration of the role of adversity in paranoia</i>	16
1.5 <i>Aims of the current review</i>	17
2. Method	18
2.1 <i>Selection of studies</i>	18
2.2 <i>Quality ratings</i>	22
3. Results	22
3.1 <i>Study characteristics</i>	22
3.2 <i>Measurement of paranoia and adversity</i>	23
3.3 <i>Associations between childhood adversity and paranoia</i>	32
3.4 <i>Role of trauma frequency and severity</i>	44
3.5 <i>Methodological limitations</i>	45
4. Discussion	48
4.1 <i>Summary of findings</i>	48
4.2 <i>Integration of findings</i>	49
4.3 <i>The role of emotional abuse in paranoia</i>	50
4.4 <i>Mechanisms from adversity to paranoia</i>	51
4.5 <i>Clinical implications</i>	53
4.6 <i>Limitations</i>	53
4.7 <i>Directions for future research</i>	54
References	56
Part 2: Empirical Paper	71
Abstract	72
1. Introduction	73
1.1 <i>Current psychological models of paranoia</i>	73
1.2 <i>Perception of contingency in paranoia</i>	75
1.3 <i>Virtual reality research in paranoia</i>	76

1.4 <i>Interpersonal Contingency</i>	77
1.5 <i>Study aims</i>	79
1.6 <i>Hypotheses</i>	80
2. <i>Method</i>	81
2.1 <i>Design</i>	81
2.2 <i>Participants</i>	82
2.3 <i>Sample size and power analysis</i>	82
2.4 <i>Ethics</i>	82
2.5 <i>Procedure</i>	83
2.6 <i>Measures</i>	93
2.7 <i>Analysis</i>	98
3. <i>Results</i>	100
3.1 <i>Sample demographics</i>	100
3.2 <i>Data screening</i>	101
3.3 <i>Pre-VR measures</i>	102
3.4 <i>Affect change following virtual reality scenario</i>	105
3.5 <i>Sense of presence, attention and contingency perception checks</i>	106
3.6 <i>Dichotomous paranoia group analyses</i>	107
3.7 <i>Paranoia continuum analyses</i>	111
4. <i>Discussion</i>	120
4.1 <i>Summary of findings</i>	120
4.2 <i>Limitations</i>	129
4.3 <i>Implications for future research and clinical practice</i>	130
References	133
Part 3: Critical Appraisal	143
1. <i>Introduction</i>	144
2. <i>Recruitment across the paranoia continuum</i>	144
3. <i>The use of virtual reality in research investigating interpersonal encounters</i>	147
3.1 <i>Virtual reality technology: Opportunities</i>	147
3.2 <i>Challenges of using virtual reality technology</i>	150
References	153
Appendices	156

List of Tables

Table	Part 1: Literature Review	Page
Table 1.	Overview of search terms used in systematic literature search PsycINFO database.	19
Table 2.	Characteristics of studies included in the literature review.	25
Table 3.	Associations between types of adversity and paranoia or persecutory delusions.	33
 Part 2: Empirical Paper		
Table 1.	Examples of types of contingent events in interpersonal relationships.	78
Table 2.	Overview of online and virtual reality study phases.	83
Table 3.	Contingency mapping participant behaviour and avatar responses.	91
Table 4.	Extract from the conversation between participant and avatar.	92
Table 5.	Group comparison of Pre-virtual reality measures.	104
Table 6.	Baseline and post-VR PANAS data and comparisons by paranoia group.	106
Table 7.	Post-VR measures by contingency condition and paranoia group.	108
Table 8.	Hierarchical regression analysis for 'explicit trust towards avatar'.	115
Table 9.	Hierarchical regression analysis for 'implicit trust' (distance kept from avatar).	117
Table 10.	Hierarchical regression analysis for 'perceived avatar empathy'.	119

List of Figures

Figure	Part 1: Literature Review	Page
Figure 1.	Flowchart of study selection process.	20
Part 2: Empirical Paper		
Figure 1.	Flow diagram of participant recruitment.	85
Figure 2.	Pictures of the virtual scenario in sequence of scenario events.	89
Figure 3.	Avatar trustworthiness rating by Paranoia category and Contingency condition.	109
Figure 4.	Avatar trustworthiness rating by Paranoia level and Contingency condition.	114

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Part 1: Literature Review

**Childhood adversity and paranoia – is there a relationship?
A systematic review of the empirical literature**

Abstract

Aims: This literature review aimed to investigate whether there is an association between direct experience of childhood interpersonal adversity and paranoia, and whether paranoia is specifically associated with a type of early interpersonal adversity.

Method: A comprehensive systematic search of the electronic database PsycINFO was conducted to identify all relevant empirical studies published up to March 2013 that reported on findings of paranoia in relation to experience of direct exposure to interpersonal childhood adversity.

Results: The search identified 35 eligible articles. Results are discussed by type of adversity, including sexual abuse, physical abuse, emotional abuse, neglect, parental care and separation experiences.

Conclusion: The results suggest that there is inconclusive evidence of a relationship between interpersonal childhood adversity and paranoia. Differences were noted between clinical and non-clinical populations. However, more consistent support was found for an association between paranoia and emotional abuse and the quality of early caregiving relationships. Possible mechanisms are considered, and results are discussed in context of methodological limitations. Clinical implications and implications for future research are discussed.

1. Introduction

1.1 Childhood adversity and psychosis

In recent years, research investigating causal factors associated with the development of psychosis has increasingly expanded its focus from biological processes to exploring environmental factors that may contribute to psychosis vulnerability (e.g. Read, Bentall & Fosse, 2009; Read, Fink, Rudegeair, Felitti & Whitfield, 2008). Environmental correlates of psychosis that have been identified include cannabis use, urban living, minority group status, social inequality, and exposure to adversity (for reviews, see Allardyce & Boydell 2006; van Os, Kenis & Rutten, 2011; van Os, Krabbendam, Myin-Germeys & Delespaul, 2005).

Childhood adversity in particular, known to be strongly associated with long-term negative effects on mental health (e.g. Greif Green et al., 2010; Read & Bentall, 2012), has received significant attention as a factor that may predispose individuals to experiencing later psychosis (e.g. for reviews, see; Bendall, Jackson, Hulbert & McGorry, 2008; Lysaker, Outcalt & Ringer, 2010; Morgan & Fisher, 2007; Read, van Os, Morrison & Ross, 2005). Whilst methodological challenges have repeatedly been highlighted with regards to demonstrating causal links between childhood adversity and psychosis (e.g. Morgan & Fisher, 2007), there is increasingly robust evidence supporting a strong relationship between early trauma and vulnerability to psychosis with evidence of causality from prospective studies (e.g. for a recent meta-analytic review, see Varese et al., 2012). Associations have been established with various forms of childhood abuse and adversity such as sexual, physical and emotional abuse and parental separation, as well as other forms of victimisation such as peer bullying (van Dam et al., 2012). Associations have been found across the psychosis continuum including non-clinical populations (Lataster et al., 2006), and there is increasing evidence of a dose-response relationship (e.g. Janssen et al., 2004; Lataster et al., 2006). Relationships between

early adversity and the content of psychotic symptoms have also been identified (e.g. Read & Argyle, 1999).

A number of (neuro)biological mechanisms linking early adversity to psychosis have been proposed, with strong support for a role of increased sensitivity to stress and implicated roles of hypothalamic-pituitary-adrenal (HPA) axis and dopamine dysregulation (for reviews, see Holtzman et al., 2013; van Winkel, Stefanis & Myin-Germeys, 2008). Read, Perry, Moskowitz and Connolly (2001) have proposed an integrative biopsychosocial Traumagenic Neurodevelopmental model, and reviewed evidence of how early adversity can be understood as a causal factor in neurodevelopmental abnormalities associated with schizophrenia¹. Cognitive and affective factors have also been implicated. Cognitive models of the positive symptoms of psychosis (Garety, Kuipers, Fowler, Freeman & Bebbington, 2001) note that early adverse experiences may result in a cognitive vulnerability to psychotic experiences through the development of negative beliefs about the self, the world and others. In a longitudinal investigation of mechanisms from early adversity to psychosis, Fisher, Schreier, et al. (2012) found evidence of a mediating role of low self-esteem, external locus of control, anxiety and symptoms of depression. Garety, Bebbington, Fowler, Freeman and Kuipers (2007) have argued for increased integration of neurobiological and cognitive processes in future paradigms.

1.2 Research specificity: a symptom-level approach

Whilst there is a substantial literature investigating links between early adversity and psychosis or schizophrenia as broad categorical outcomes, a symptom-focused approach has been advocated by some researchers in the field as an important way

¹ There is an ongoing debate in the literature about the developmental process of Post-traumatic stress disorder (PTSD) and psychosis as reactions to trauma that is beyond the scope of the current review.

forward and has increasingly been adopted (Bentall, 2006; Bentall, Corcoran, Howard, Blackwood & Kinderman, 2001; Garety et al., 2007). Increasing evidence has been gathered for the specific importance of social factors in paranoia. For example, the NEMESIS study (Rutten, van Os, Dominguez & Krabbendam, 2008) found that urban living, discrimination and victimisation experiences were associated with persecutory delusions. The argument for moving away from a broad diagnostic approach has further been supported by findings that certain types of childhood adversity may be differentially associated with specific psychotic symptoms (Bentall & Fernyhough, 2008). For example, there seems to be stronger evidence for an association between sexual abuse and hallucinations than delusions (e.g. Bentall, Wickham, Shevlin & Varese, 2012; Read & Argyle, 1999).

Specificity in research into associations between childhood adversity and delusions is also likely to be important, as different psychological processes are involved in different types of delusions such as paranoid and grandiose delusions (Garety et al., 2013), and Freeman (2007) notes they therefore merit their separate investigation. A symptom-level approach to psychotic experience has led to more specific cognitive models such as those developed for persecutory delusions (Bentall et al., 2001; Bentall, Kinderman & Kaney, 1994; Freeman, Garety, Kuipers, Fowler & Bebbington, 2002; Trower & Chadwick, 1995), grandiose delusions (Knowles, McCarthy-Jones & Rowse, 2011) and delusions of reference (Startup, Bucci & Langdon, 2009). There has been a related trend for psychological interventions to be more targeted to specific psychotic experiences, such as command hallucinations (Birchwood et al., 2011) with promising initial results of large effect sizes (Trower et al., 2004). Similar increased specificity in interventions of persecutory delusions is evidenced by a recent randomised control trial with a main focus on reducing worry (Freeman, Dunn, Startup & Kingdon, 2012).

Research into paranoia has often been undertaken within a continuum framework following evidence that paranoid ideation is found in the general

population (e.g. Ellett, Lopes, & Chadwick, 2003; Freeman et al., 2005) and exists on a continuum, ranging from subclinical levels of paranoia in the general population to the more severe end of clinical symptoms of persecutory delusions (Freeman, 2007). Investigations into non-clinical experiences of paranoia are therefore considered to advance knowledge of clinical persecutory delusions (Freeman, 2007). A continuum view is further supported by findings that cognitive and affective factors (e.g. anxiety) relevant to paranoid ideation have been found to be associated with paranoia in different samples in both clinical and non-clinical populations (e.g. Freeman, Pugh, Vorontsova, Antley & Slater, 2010), and the role of gene-environment interactions highlighting the importance of environmental factors in determining whether genetic vulnerability results in experience of a psychotic disorder (van Os, Kenis & Rutten, 2011). Whilst there is increasing evidence in support of a continuum view of psychosis, there are also findings that suggest that the distribution of the psychosis phenotype may not be completely continuous in the general population (Linscott & van Os, 2010).

1.3 The role of adversity in current theoretical models of paranoia

Current cognitive models of persecutory delusions emphasise the role of internal and cognitive factors in the development of paranoia, with particular emphasis on reasoning biases and affective processes (e.g. Bentall, 1994, 2001; Freeman et al., 2002). Within these cognitive models, experience of early adversity is however assumed to be a factor of likely importance in the development of these processes, predisposing individuals to a paranoid worldview.

Within the threat anticipation model of persecutory delusions (Freeman et al., 2002; Freeman, 2007; Freeman & Garety, 2004), life events are included as possible triggers for episodes of paranoia through giving rise to internal experiences that may subsequently be interpreted as threatening. Adversity experienced earlier

in life is also considered to be relevant, as past experience of victimisation is considered to make it more likely for an individual to infer hostility in the future (Freeman, Garety & Fowler, 2008). As individuals make use of their past experiences when trying to make sense of internal and external events, negative schematic beliefs about the self as vulnerable, or other people and the world as dangerous or hostile formed through past experiences, are considered to increase the likelihood that a persecutory appraisal will be made, and this impact is compounded by pre-existing affective disturbances (Freeman & Garety, 2004).

Negative beliefs about the self and early experiences also play an important role in Bentall et al.'s (1994; 2001) attributional theory of paranoia, which explains persecutory delusions as the result of external attributions made by an individual about negative events being caused by others, in order to protect the self from feelings of low self-esteem. Drawing links with previous research on associations between victimisation experiences and paranoid ideation and research on the impact of early family relationships on cognitive processes relevant to paranoia, Bentall et al. (2001) postulate that vulnerability to low self-esteem and a style of making external attributions in response to these feelings is likely to have their origins in early experiences with caregivers.

Trower and Chadwick (1995) have detailed how different negative experiences of early care may lead to two different types of paranoia through two distinct pathways. They proposed that persecutory delusions can be categorised into 'poor me' and 'bad me' presentations, where individuals believe that persecution is either unjust ('poor me' paranoia) or deserved ('bad me' paranoia). Trower and Chadwick (1995) associate 'poor me' paranoia with early experiences of caregivers who were neglectful, resulting in an intolerable threat to their self-image which is defended against through seeing others as persecuting. In contrast, 'bad me' paranoia is proposed to be associated with care characterised by caregiver over intrusiveness and control, which is proposed to result in a self-protective avoidant

style of relating to others as a way of avoiding criticism due to negative expectations of interpersonal interactions (Melo, Taylor & Bentall, 2006).

In integrative accounts of the biological and psychological processes in paranoia, the inherent role of dopamine in threat appraisal and related associations with dopamine increase following repeated stress has been highlighted (Moutoussis, Williams, Dayan & Bentall, 2007; Read et al., 2001). Insecure attachment as a result of early trauma has been proposed as a mechanism linking childhood adversity with psychosis (Read & Gumley, 2008) and to be one link between the biological and psychological processes involved in psychosis (Read et al., 2009). Different hypothesised pathways between adversity types and different symptoms have been proposed and have started to be explored (Bentall & Fernyhough, 2008; Bentall et al., 2012). In light of recent findings that attachment may be more associated with paranoia than hallucinations (Pickering, Simpson & Bentall, 2008), Bentall and Fernyhough (2008) propose that attachment may be specifically relevant to the development of paranoia. In their model of a pathway between childhood victimisation to paranoid beliefs, they postulate that early victimisation experiences and associated insecure attachment result in social threat anticipation, mediated by reduced self-esteem and an externalising reasoning bias.

1.4 Previous consideration of the role of adversity in paranoia

Qualitative accounts of the impact of trauma often highlight the negative and long-lasting consequences of adverse interpersonal experiences such as abuse on an individual's ability to trust others (e.g. Pitre, Kushner & Hegadoren, 2011). Mistrust of others has been identified as an important variable in delayed disclosure of childhood sexual abuse (Somer & Szwarcberg, 2001). Considerable empirical attention has been given to further elucidating the cognitive and affective factors implicated in models of persecutory ideation (for recent examples, see Fowler et al.,

2012; Freeman, Dunn, Fowler, et al., 2012; Thewissen et al., 2011). In contrast, whilst reference is made to relevant studies showing links between victimisation and paranoia, the role of early adversity in the development of paranoia has not been systematically reviewed. In a review looking at the role of childhood adversity in psychosis, Read et al. (2005) considered specific findings in relation to delusions, including persecutory ideation. However their conclusions are limited by the fact that this review included studies where different types of delusions were not differentiated, as is the case for many studies investigating associations between childhood adversity and delusions (e.g. Bartels-Velthuis, van de Willige, Jenner, Wiersma & van Os, 2012; Saha et al., 2011). The only known non-systematic review of the literature on the impact of early adversity on paranoia specifically (Read, Goodman, Morrison, Ross & Aderhold, 2004) suggested that hallucinations may be more strongly associated with childhood adversity than paranoia and that there may be a stronger link between physical abuse and paranoia, but the authors suggested that the evidence was inconclusive.

1.5 Aims of the current review

In contrast to the general psychosis literature, whilst there is increasing research looking into associations between childhood adversity and paranoia, to the author's knowledge no systematic review to date has been carried out looking at the impact of early adversity on paranoia specifically. The current review therefore aimed to systematically review the empirical evidence to date, to investigate the following questions:

1. Is there an association between direct experience of childhood interpersonal adversity and paranoia?
2. Is paranoia associated with a specific type of early interpersonal adversity?

In answering these questions, the review aims to clarify current understanding of the strength of the association and the specificity of associations with different types of childhood adversity. Given the interpersonal nature of paranoia, the focus of the current review will be on direct experiences of an interpersonal nature. Consistent with a continuum view of paranoid ideation, the current review will explore the above questions considering experience of paranoia across the continuum, including research with both clinical and non-clinical populations.

2. Method

2.1 Selection of studies

2.1.1 Search strategy

A comprehensive search of the electronic database PsycINFO was conducted to identify all relevant empirical studies published up to March 2013. Table 1 lists all adversity and paranoia-related search terms used. Adversity related search terms were combined with the search terms 'child*'; 'adolescent*' and 'early' to identify papers specifically relevant to childhood adversity. The childhood adversity terms were combined with paranoia-related search terms. This search was repeated with the broader search terms of delusions and 'psychosis symptoms' or schizotypy in order to identify any additional relevant papers including relevant data on paranoia that may have been missed in the initial paranoia-specific search. In addition to the electronic search, manual searches including examination of references in selected studies were conducted to identify further relevant articles. A flowchart indicating the selection of studies during each step of the search is presented in Figure 1.

Table 1. Overview of search terms used in systematic literature search PsycINFO database.

Childhood adversity	Paranoia
<i>Child* abuse* (SH)</i> <i>Early abuse* / care*</i> <i>Child* care*</i> <i>Parent* / child* care*</i> <i>Parent* loss / separati* / death*</i> <i>Child*/early/parent*/care* threat*</i> Terms below were combined with ‘early’; child* and ‘adolescen*’. <i>Life event*</i> <i>Expos* / famil* violen*</i> <i>Exposure to violence (SH)</i> <i>Maltreat*</i> <i>Traum*</i> <i>Adversit*</i> <i>Adverse care* / experience* / event*</i> <i>Victim* (and SH ‘victimization’)</i> <i>Sexual* abuse* (SH)</i> <i>Incest* (SH)</i> <i>Rape (SH)</i> <i>Physical* abuse* (SH and SH ‘battered child syndrome’)</i> <i>Emotional* abuse* (SH)</i> <i>Verbal* abuse* (SH)</i> <i>Neglect* (SH ‘child neglect’)</i> <i>Domestic violence (SH)</i> <i>Bullying (SH and SH ‘teasing’)</i> <i>Bullied</i> <i>Separati*</i> <i>Abandonment (SH)</i>	<i>paranoi*</i> <i>persecut* delusion* / ideation*</i> <i>suspicious*</i> <i>mistrust*</i> <i>distrust*</i> <i>dis-trust*</i> <i>mis-trust*</i> <i>paranoia (SH)</i> <i>paranoia (psychosis) (SH)</i> <i>paranoid schizophrenia (SH)</i> <i>Symptom* psychosis / psychotic* / schizo*/positive</i> <i>Delusion*</i>

Note: SH= search was also run with this term as a Subject Heading within PsycINFO

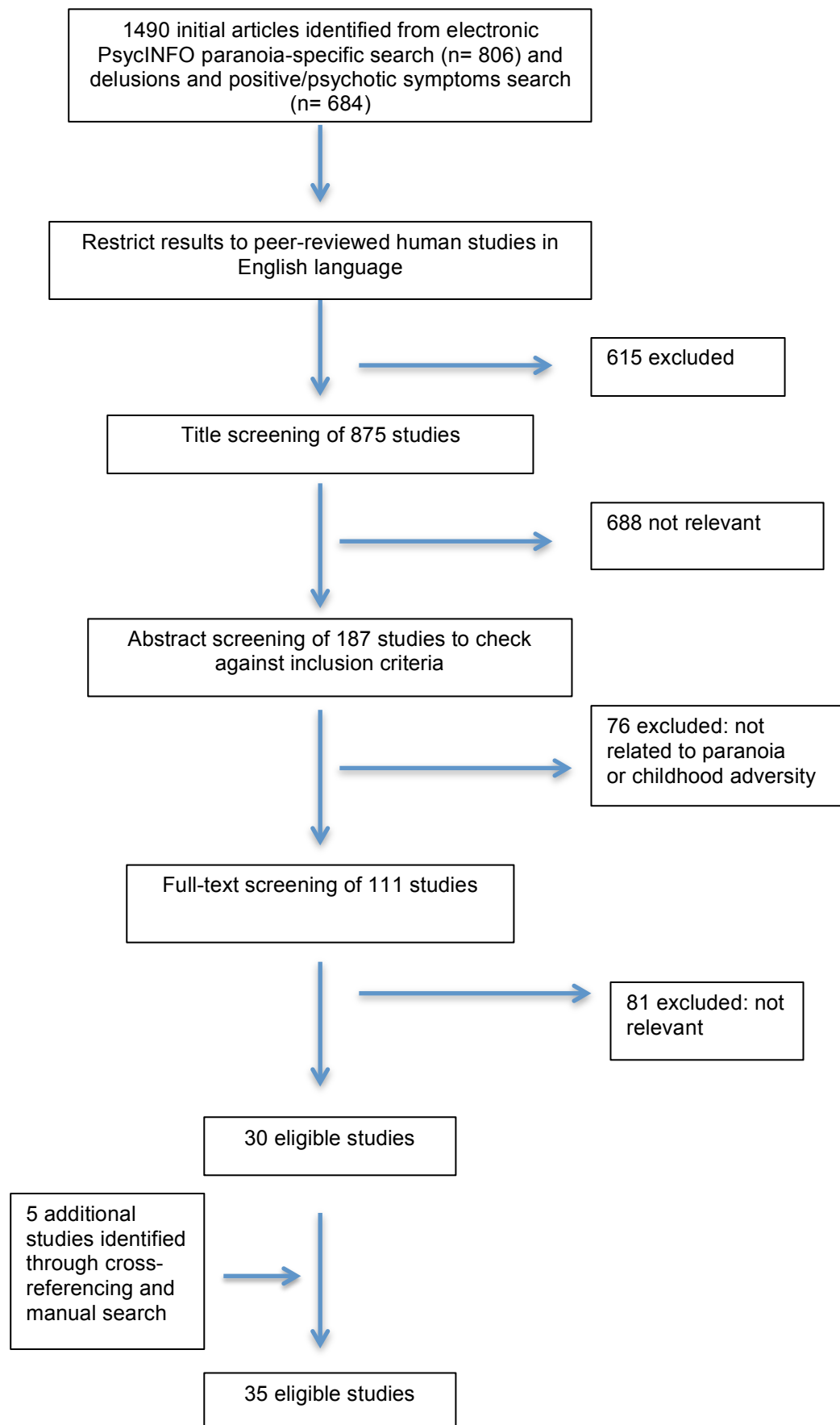


Figure 1. Flowchart of study selection process.

2.1.2 Inclusion and exclusion criteria

Only peer-reviewed quantitative empirical studies published in English were included in the current review. No exclusion criteria were applied with regards to study design; studies could have a cross-sectional, case-control or longitudinal design. Studies were included if they investigated associations between childhood (experienced before the age of 18) interpersonal proximal adverse events and paranoia, persecutory delusions, suspiciousness or mistrust where the latter two concerned general mistrust of 'others' rather than towards specific individuals or groups. For reasons of feasibility and specificity of the current review, identified articles examining links between childhood adversity and psychosis, schizophrenia or schizotypy that did not indicate inclusion of paranoia data in the title or abstract, were not further examined.

Studies were excluded if adverse events were not clearly interpersonal in nature (e.g. natural disasters) or if proximal exposure was unclear (e.g. 'war'). Studies that incorporated interpersonal and non-interpersonal traumatic events within a single measure of adversity were retained for inclusion. For inclusion studies needed to have employed a paranoia-specific measure; combinations of paranoia with other constructs (e.g. 'paranoia-hostility') were excluded.

As the main focus of the current review was on paranoia within the psychosis continuum, studies of paranoia within personality disorders, including paranoid personality disorder, were excluded. The only exception to this was schizotypal personality disorder due to the association between schizotypy and psychosis proneness (Mason et al., 2004). Similarly, studies investigating paranoia through personality measures (e.g. MMPI) were excluded, with exception of schizotypal measures.

2.2 Quality ratings

Selected studies were ranked in quality using the quality assessment tool for quantitative studies by Kmet, Lee and Cook (2004), which was adapted to include only the general quality indicators most relevant to the review. In addition, two additional items of particular importance relating to the quality of the paranoia and adversity measures used were added to the checklist. The adapted checklist used is presented in Appendix 1. In accordance with the rating scheme by Kmet et al. (2004), each study was given a score between 0 and 2 on each of the quality criteria; however additional sub-questions were added to the quality scoring of the paranoia and adversity measures used, where studies were scored between 0 and 8 to reflect different quality dimensions. A higher value was given to these dimensions as they were considered critical to the current review. Each study could be assigned a maximum of 26 points. The ratings were mainly used as a guide for which studies were given more weight in the review. For example, in order to control for possible bias in the search strategy, studies which looked specifically at paranoia or persecutory delusions were ranked more highly than those which employed generic symptom checklists, as the latter were more likely to be identified through key words in the current search by virtue of having had a positive association. Therefore the rankings should not be interpreted as general quality indicators of the studies but as review specific indicators of quality and in order to minimise bias.

3. Results

3.1 Study characteristics

Thirty-five eligible studies were identified for the current review. Characteristics of the selected studies are presented in Table 2. There were a similar number of studies which investigated associations between paranoia and early adversity in

non-clinical (n=18) samples compared to those with clinical (n=17) populations. All of the non-clinical and many of the clinical population studies were cross-sectional in design, with some clinical studies employing control groups. Only one study was a longitudinal investigation.

3.2 Measurement of paranoia and adversity

Paranoia has been defined in different ways in the literature. As the current review concerns paranoid ideation across the continuum rather than only clinical levels of persecutory delusions, the studies included have varying operational definitions of paranoia and associated with this, varied measures of paranoia. Freeman and Garety (2000) have defined persecutory beliefs as the individual's belief that the persecuting other has the intention to cause them harm. Such persecutory ideation of intention of harm by others also occurs at a non-clinical level in the general population (Freeman, 2007).

A wide range of paranoia measures was used in the studies included in the current review, not all of which are consistent with Freeman and Garety's (2000) definition of persecutory beliefs. Some studies used measures specific to assessing paranoia, such as the Paranoia Scale (Fenigstein & Venable, 1992), which was used in three studies. This measure has good reliability and convergent validity, and assesses mild paranoid ideation, including a limited number of questions on harm and only one regarding intent of harm (Freeman, 2008). The Green et al. Paranoid Thoughts Scale (G-PTS; Green, Freeman & Kuipers, 2006), which is a clear measure of persecutory ideation with good psychometric properties (Freeman, 2008), was only used by one study (Freeman & Fowler, 2009). Only one of the studies used a 'state' rather than 'trait' measure of paranoia (Freeman, Pugh, et al., 2008), assessing paranoia evoked during a virtual train ride. Two studies examined paranoia using items on measures of schizotypy. Many other studies in the current

review measured paranoia as one variable within a checklist of general psychopathology such as the Symptom Checklist-90-R (Derogatis, 1994) or the Brief Symptom Inventory (Derogatis, 1993), which measure paranoid ideation through six questions only, including some items relating to mistrust and one regarding feelings of being watched or followed, but none clearly identifying ideas of persecution. Measures used in studies with clinical samples include diagnostic interviews to assess persecutory ideation, as well as clinician rated scales such as the Brief Psychiatric Rating Scale (BPRS; Ventura, Lukoff, Nuechterlein, Green & Shaner, 1993).

Most of the studies in the current review used retrospective self-report questionnaires of abuse, which have often been critiqued for the potential biases associated with this approach. However, self-reported history of childhood abuse by patients experiencing current psychosis has been found to be reliable and stable over time, with good convergent validity with clinical case notes (Fisher et al., 2011). Self-report measures of abuse used in the studies ranged from single questions to comprehensive measures such as the Childhood Trauma Questionnaire (CTQ; Bernstein & Fink, 1998), which has good reliability and validity (Bernstein et al., 1994). In addition to these studies using measures clearly assessing specific types of trauma, there are other studies that include data on negative emotional qualities of parenting, for example using questionnaires inquiring about experiences of threat in the family home using the Early Life Experiences Scale (ELES; Gilbert, Cheung, Grandfield, Campey & Irons, 2003), or general quality of parenting care measured with the Parental Bonding Instrument (PBI; Parker, Tupling & Brown, 1979). This measure has a 'Caring' scale, where low scores reflect neglect and a lack of emotional responsiveness, as well as an 'Overprotection' scale, where high scores reflect intrusive and controlling parenting (Read, 2013).

Table 2. Characteristics of studies included in the literature review.

Sample type	Study	Sample	Study design	Paranoia measure	Adversity type	Adversity measure	Findings
Non-clinical sample studies	Fisher et al. 2012 (UK)	N= 212 general population	Cross-sectional	PSQ 2 paranoia items (past year)	EA, PA, SA, EN, PN	CTQ	Elevated rates of paranoia only in EA (OR = 3.26) and PA (OR=3.15).
	Bentall et al. 2012 (UK)	N= 7,353 (16+ years) English population	Cross-sectional	PSQ 1 paranoia item (past year)	SA, PA, Bullying, Separation experiences	Individual yes/no questions. Bullying experience was selected from a list.	Paranoia was associated with institutional care (OR=11.08) and PA (OR=8.52), but SA was not a significant predictor of paranoia once hallucinations were controlled for. Bullying was not associated with paranoia.
	Murphy et al. 2012 (UK)	N= 179 undergraduate students	Cross-sectional	IPDE paranoia subscale (past 5 years)	Parental threat	ELES – threat scale only	Direct effect early threat memories on adult paranoia.
	Pinto-Gouveia et al. 2012 (Portugal)	N= 255 general population	Cross-sectional	PS	Threat and submissiveness in childhood	ELES	Early emotional memories of threat and submissiveness predicted paranoid ideation.
	Al-Krenawi & Graham 2012 (Palestinian territories)	N= 971 school-attending Palestinian adolescents on West Bank and Gaza Strip	Cross-sectional	BSI paranoid ideation subscale (past week)	Political violence (family and personal exposure to violent events)	Traumatic Event Questionnaire (author's own measure)	Exposure to violence was a predictor of paranoid ideation.
	Barker-Collo & Read 2011 (New Zealand)	N= 338 adults New Zealand population	Cross-sectional	SCL-90-R paranoid ideation subscale (past week)	PA, SA	Yes or No questions	Higher paranoid ideation in those with a history of PA and SA compared to those not abused, but no association found with history of single exposure to PA or SA. Gender analyses showed an association with SA for men only.

Non-clinical sample studies	Murphy et al. 2010 (USA)	N= 67 adolescents treated for orofacial injury in past 12 months: single intentional, double intentional or unintentional injury	Case-control	BSI paranoid ideation subscale (past week)	Single or double intentional injury (e.g. from fighting or being attacked) in past 6 months Unintentional injury (e.g. car accident)	Medical record data and Adolescent Injury Checklist	Adolescents with intentional injuries had higher levels of paranoia than those unintentionally injured.
	Steel et al. 2009 (UK)	N= 384 university staff/students	Cross-sectional	Schizotypal Personality Scale (STA) paranoid suspiciousness factor	PA, EA, SA	Adapted version of TLEQ (added question on EA)	PA and SA associated with high levels of paranoia/suspiciousness Paranoia not associated with experience of multiple abuse types.
	Freeman & Fowler 2009 (UK)	N= 200 general public	Cross-sectional	Paranoid Thoughts Scale-Part B (trait paranoia)	SA, PA Only events reaching threshold for PTSD severity	Life Stressor Checklist	No difference in paranoia when comparing those with history of childhood abuse to those without, but SA was associated with paranoia compared to those not abused.
	Freeman et al. 2008 (UK)	N= 200 general public	Cross-sectional	State Social Paranoia Scale	Number of childhood abuse events reaching threshold for PTSD severity (incl. SA)	Life Stressor Checklist	No. of childhood abuse events not significant predictor of state paranoia (OR=1.05).
	Meins et al. 2008 (UK)	N= 154 adults	Cross-sectional	SPQ paranoia subscale	Parental care and overprotection	PBI	Suspiciousness/paranoia was predicted by lower perceived paternal care.

Non-clinical sample studies	Gracie et al. 2007 (UK)	N= 228 students	Cross-sectional	PS	PA, SA, EA/EN, PN, witnessing family violence (composite score)	TLEQ + two added questions composed CTQ to assess EA, EN, PN	Experience of childhood interpersonal trauma higher levels of paranoia compared to those who did not experience childhood trauma.
	Campbell & Morrison 2007 (UK)	N=373 pupils 14-16 yrs old	Cross-sectional	PS	Peer bullying	BVQ victimisation scale	Experience of bullying associated with predisposition to paranoia.
	Perry et al. 2007 (USA)	N= 130 65 newlywed couples	Cross-sectional	BSI paranoid ideation subscale (past week)	EA, EN	CTQ	For males only: higher EA related to higher paranoia and paranoia subscale mediated relationship EA and decrease in marital satisfaction.
	Young et al. 2007 (USA)	N= 406 undergraduate students	Cross-sectional	BSI paranoid ideation subscale (past week)	SA	ESE	Those with history of SA endorsed greater paranoid ideation. No gender difference found.
	Haj-Yahia & Tamish 2001 (Israel)	N= 652 Palestinian adult students	Cross-sectional	BSI paranoid ideation subscale (past week)	SA before 12, from 12-16, and over age of 16	Adapted version of Finkelhor's (1979) scale for measuring sexual abuse	Sexual abuse by immediate family member, relative or stranger was associated with paranoia compared to those not abused. The more frequent the abuse, the higher the level of paranoid ideation, regardless of age at time of abuse.
	Martin & Elmer 1992 (USA)	N= 19 adults who received hospital treatment as a child for judged abuse injury	Longitudinal	Suspicion component on aggression subscale of the Hostility-Guilt Inventory	Severe PA	Identified in hospital at time of abuse	Suspicion scores of those with history of severe PA were considerably higher than college and hospital patients norms.
	Murphy et al. 1988 (USA)	N= 391 adult female community sample	Cross-sectional	SCL-90-R paranoid ideation subscale	SA	Screening questions	Higher paranoid ideation in those with history of CSA compared to those without.

Clinical sample studies	Ashcroft et al. 2012 (UK)	N= 59 in- and outpatients with schizophrenia with persecutory delusions (n=36) and without (n=35)	Case-control	SCID	SA, PA, EA, PN, EN	CTQ	Persecutory delusions were associated with higher reported history of EA and trend for EN. No differences between patients with and without persecutory delusions in total trauma score or history of PA, PN, or SA.
	Falukozi & Addington 2012 (Canada)	N= 45 at risk individuals aged 14-35 with diagnosis of attenuated psychotic symptom syndrome	Cross-sectional	The Content of Attenuated Positive Symptoms (CAPS) Codebook was used to assess the content of attenuated positive symptoms (symptoms based on the SOPS suspicion/paranoia symptom scale)	SA, PA, EN, psychological abuse, psychological and physical bullying	The Abuse/Trauma Questionnaire (overall trauma rating) Semi-structured interview	History of previous trauma related to feeling watched or followed.
	Lopes 2011 (Portugal)	N= 61 patients with paranoid schizophrenia (n=31) or social anxiety disorder (n=30)	Cross-sectional	Paranoia Checklist BPRS	Bullying since childhood to present	BVQ (victimisation section)	Patients with paranoid schizophrenia reported more experiences of bullying than those with social anxiety. Higher frequency of paranoid thoughts with higher conviction and distress in victims of bullying compared to those not bullied. More reports of persecutory delusions in interview.
	Morris et al. (2011)	N= 36 patients with persecutory delusions. 'Poor-me' (PM) paranoia type (n=21) or 'Bad-me' (BM) paranoia type (n=15)	Cross-sectional	Staff report & SAPS	Parental care and overprotection	PBI	PM group did not show higher levels of parental neglect. BM reported higher level of overprotection

Clinical sample studies	Colins et al. 2009 (Belgium)	N= 231 detained male adolescents of Belgian or Moroccan origin	Cross-sectional	DISC-IV (5 paranoia-related experiences in past year)	SA,PA,PN, EA, EN	CTQ - Short Form	EA, EN and PN were associated with paranoia-related symptoms. In best fit model, EA emerged as main predictor of paranoia-related symptoms.
	Thompson et al. 2009 (USA)	N= 30 (13-25 years) prodromal to psychosis	Cross-sectional	SIPS/SOPS suspiciousness symptom	PA, EA, SA	Early Trauma Inventory	Exploratory analyses suggested a relationship between suspiciousness and PA.
	Melo et al. 2006 (UK)	N= 65: Patients with persecutory delusions (n=44) Non-clinical control group (n=21)	Case-control	SCAN (at least score of 2 on paranoia items). PDP scale used for PM ('poor me') or BM ('bad me') categorisation	Parental care and overprotection	PBI	Those with PM paranoia reported lower maternal care than control group. No difference in paternal care or overprotectiveness.
	Mason et al. 2009 (UK)	N= 50 adult patients with psychotic disorder with delusional component	Cross-sectional	Patient case notes and SCAN-2.1 relevant sections + thematic analysis of themes	EA, PA, SA, EN, PN	CTQ	No relationship found between paranoid delusions and any of the abuse types.
	Schenkel et al. 2005 (USA)	N= 40 adult inpatients psychiatric rehabilitation unit	Cross-sectional	BPRS paranoia factor	SA, PA, neglect	Medical chart review based on data from interview on admission	No association between paranoia and history of abuse.
	Rankin et al. 2005 (UK)	N= 38 adults -Patients with persecutory delusions in treatment (n=14) -Patients in remission (n=9) -Healthy controls (n=15)	Case-control	DSM-IV criteria for paranoid schizophrenia PANSS suspiciousness/persecution and delusions section to verify for remitted group	Perceptions of parental care and overprotection	PBI	Both currently ill and remitted patients reported lower parental care. Patients with persecutory delusions reported higher overprotection than controls.

Clinical sample studies	Read et al. 2003 (New Zealand)	N= 200 adult patients with varying mental health diagnoses	Cross-sectional	DSM-IV characteristic symptoms of schizophrenia: delusions – subtype paranoid delusions	SA, PA	Review of medical records	Paranoid ideation unrelated to history of childhood abuse. Paranoid delusions evident in 36% of incest cases. SA only related to paranoia when accompanied by history of adult sexual abuse.
	Cavaola & Schiff 2000 (USA)	Chemically dependent adolescents inpatients n= 150 Non-abused chemically dependent control group n= 60 Non-chemically dependent control group n= 60	Case-control	SCL-90-R paranoid ideation subscale	PA, SA, Incest, Incest and PA	Adolescent Life Events Inventory Questionnaire Interview data grouped according to definitions and criteria of abuse by Kempe & Kempe (1984)	Abused group higher paranoia. Paranoid ideation one of subscales that best differentiated the abused group from non-abused group. Those with history of incest <i>and</i> PA had more extreme levels of paranoia.
	Ross et al. 1994 (USA)	N= 83 adult inpatients and outpatients with diagnosis of schizophrenia	Cross-sectional	Diagnostic Interview Schedule (DIS) (section for schizophrenia)	SA and PA	Dissociative Disorders Interview Schedule	Significantly higher paranoia in those with history of abuse.
	Mundy et al. 1990 (USA)	N= 96 homeless adolescents	Cross-sectional	3 questions on HAIS for paranoid ideation (from psychotic symptoms section on the DIS)	Neglect, PA, Extrafamilial PA, SA, Extrafamilial SA	Homeless Adolescent Interview Schedule	Only PA associated with paranoid ideation.
	Swett et al. 1990 (USA)	N= 125 men attending psychiatric outpatient clinic	Cross-sectional	SCL-90-R paranoid ideation subscale	PA, SA, PA+SA	Direct specific questions (analysis differ in age boundaries)	Association SA and PA with paranoia not significant (with bonferroni correction).

Clinical sample studies	Surrey et al. 1990 (USA)	N= 140 female inpatients	Cross-sectional	SCL-90-R paranoid ideation subscale	PA, SA or both	Life Experiences Questionnaire	When recent traumas controlled for (excluded from analysis), no association with paranoia.
	Breyer et al. 1987 (USA)	N= 68 adult female inpatients	Cross-sectional	SCL-90-R paranoid ideation subscale	PA or SA or both	Direct specific questions starting with 'before (or after) you were 16 years old', etc.	Those who had been sexually or physically abused as children higher paranoid ideation scores than those not abused. Those experienced both types even higher scores of paranoia.

Note: SA= (childhood) Sexual abuse; PA= (childhood) Physical abuse; EA= (childhood) Emotional abuse; EN= (childhood) Emotional neglect; PN= (childhood) Physical neglect. *Measures:* BPRS= Brief Psychiatric Rating Scale; BSI= Brief Symptom Inventory; BVQ= Bully/Victim Questionnaire; CTQ= Childhood Trauma Questionnaire; DIS= Diagnostic Interview Schedule; DISC-IV= Diagnostic Interview Schedule for Children-IV; DSM-IV= Diagnostic and Statistical Manual of Mental Disorders, 4th edition; ELES= Early Life Experiences Scale; ESE= Early Sexual Experiences questionnaire; HAIS= Homeless Adolescent Interview Schedule; IPDE= International Personality Disorder Examination; PANSS= Positive and Negative Syndrome Scale; PBI= Parental Bonding Instrument; PDP= Perceived Deservedness of Persecution analogue scale; PS= Paranoia Scale; PSQ= Psychosis Screening Questionnaire; SCAN= Schedules for Clinical Assessment in Neuropsychiatry; SCID= Structured Clinical Interview for DSM-IV; SCL-90-R= Symptom Checklist-90-Revised; SAPS= Scale for Assessment of Positive Symptoms; SIPS/SOPS= Structured Interview for Prodromal Syndromes/Scale of Prodromal Symptoms; SPQ= Schizotypal Personality Questionnaire; TLEQ= Traumatic Life Events Questionnaire.

3.3 Associations between childhood adversity and paranoia

In line with the wider psychosis literature, the studies identified in the current review have between them examined associations between a range of different types of early adversity and paranoia. An overview of associations examined between different types of adversity and paranoia are presented in Table 3 (alongside the studies' quality ratings), following a previous example of this format set in a review by Read et al. (2005). Abuse categories were included in this table if three or more studies investigated associations with paranoia. As a result, some adversity types are not included here. It is of note that some of the studies investigated associations using a composite measure, which could be a total trauma score across different trauma types, or categorical abused versus not abused status. As can be seen in Table 3, six studies used only such a composite score or categorical variable, and four of these found a positive association (Cavaiola & Schiff, 2000; Falukozi & Addington, 2012; Gracie et al., 2007; Ross, Anderson & Clark, 1994). Whilst informative, a limitation of using composite measures or abused versus not abused categories where they are not supplemented by separate analyses, is that it is difficult to differentiate the different contributions of each type of adversity, and to infer whether the effect is generic or specific to a particular type of trauma and therefore to compare results with other studies. As different mechanisms have been proposed to account for associations between specific types of adversity and different symptoms of psychosis (e.g. Bentall & Fernyhough, 2008; Bentall et al., 2012), it was therefore considered relevant to review associations per type of adversity.

Table 3. Associations between types of adversity and paranoia or persecutory delusions.

Sample type	Study	SA	PA	Lack of nurturing environment			Bullying	Composite	Quality rating
				EA	Neglect	Parental care			
Non-clinical	Fisher et al. 2012	0	+	+	0				22
	Bentall et al. 2012	0	+				0		22
	Murphy et al. 2012			+					20
	Pinto-Gouveia et al. 2012			+					21
	Barker-Collo & Read 2011	+ ^a	0						14
	Murphy et al. 2010		+ ^b						16
	Steel et al. 2009	+	+	0					21
	Freeman & Fowler 2009	+	0					0	22
	Freeman et al. 2008							0	22
	Meins et al. 2008					+			20
	Gracie et al. 2007							+	21
	Campbell & Morrison 2007						+		21
	Perry et al. 2007			+ ^a	0 ^c				21
	Young et al. 2007	+							19
	Melo et al. 2006					+			20
	Haj-Yahia & Tamish 2001	+							19
	Martin & Elmer 1992		+						16
	Murphy et al. 1988	+							19
Clinical	Ashcroft et al. 2012	0	0	+	(+)			0	20
	Falukozi & Addington 2012							+	18
	Lopes 2011						+		18
	Colins et al. 2009	0	0	+	+				22
	Thompson et al. 2009	0	+	0				0	20
	Mason et al. 2009	0	0	0	0				22
	Schenkel et al. 2005							0	16
	Read et al. 2003	0	0						20
	Rankin et al. 2003					+			20
	Cavaiola & Schiff 2000							+	17
	Ross et al. 1994							+	20
	Mundy et al. 1990	0	+		0				19
	Swett et al. 1990	0	0						19
	Surrey et al. 1990	0	0						20
	Bryer et al. 1987	+	+					+	19
No. +/ No. investigations		7/17	8/16	6/9	1/6	3/3	2/3	5/10	

Note: SA= sexual abuse; PA= physical abuse; EA= emotional abuse

+, $p < 0.05$; 0, no association; (+), non-significant trend; blank, relationship not assessed

^a Association for males only

^b This study investigated physical assault including fights with others

^c Investigated for females only

3.3.1 *Sexual abuse*

The impact of childhood sexual abuse (CSA) has been investigated by the largest number of studies in the current review. Seventeen studies looked at this association separately. Strikingly, only seven of these found an association with paranoia. Notably more associations were found in non-clinical studies (six out of eight), compared with clinical samples where only one of nine studies found an effect. When taking quality ratings into account, however, only two of the ten most highly rated studies found a relationship (Freeman & Fowler, 2009; Steel, Marzillier, Fearon & Ruddle, 2009). A further five studies included CSA in a composite trauma measure (Cavaiola & Schiff, 2000; Falukozi & Addington, 2012; Freeman, Pugh, et al., 2008; Gracie et al., 2007; Ross et al., 1994), however as it is difficult to ascertain the different contributions of each adversity type to the composite associations, these will not be considered here.

In a general population sample of 212 adults, Fisher, Appiah-Kusi and Grant (2012) found no relationship between CSA as measured by the CTQ (Bernstein et al., 2003) and paranoia as measured by two strong paranoia indicators on the Psychosis Screening Questionnaire (PSQ; Bebbington & Nayani, 1995). Using a shortened version of the same CTQ, Collins et al. (2009) also found no relationship between CSA and any paranoia-related experience (ranging from clear persecutory delusions to thoughts less clearly unjustified of being talked or laughed about by people) in a large forensic sample of 231 males. No relationship was also found by Mason, Brett, Collinge, Curr and Rhodes (2009) between persecutory content of delusions and a history of CSA in a patient sample, but a positive association was found with the paranoia/suspiciousness dimension of schizotypy in a non-clinical sample (Steel et al., 2009).

A study by Read, Agar, Argyle and Aderhold (2003) raises an interesting and important issue about the role of adult trauma in long-term vulnerability from childhood trauma. In a patient sample with a range of clinical diagnoses they found

that CSA was only associated with persecutory delusions when individuals had also experienced adult sexual abuse. Whilst Read et al. (2003) may have missed abuse cases from the way abuse was coded on the basis of case files, Surrey, Swett, Michaels and Levin (1990) found that the association between CSA and paranoid ideation in an all female inpatient sample (n=140) was no longer significant when they controlled for the effects of adult sexual abuse.

Using data from a large population survey (n=7353), Bentall et al. (2012) specifically looked at the association between different types of childhood adversity and paranoia. Importantly, their findings demonstrate the importance of controlling for the effects of comorbid psychotic symptoms such as hallucinations. Whilst their measures of paranoia and CSA were somewhat limited, they found that childhood rape was strongly associated with hallucinations and once these were controlled for, it was no longer associated with paranoia.

A discrepancy in the findings by Freeman and Fowler's (2009) and Freeman, Pugh, et al. (2008) raises an interesting issue about the importance of the type of paranoia measure used. Using clear but restrictive indicators of CSA (i.e. the experience of unwanted sex or touch through force or threat which were only scored when the experience was severe enough to meet PTSD related criteria), Freeman and Fowler (2009) clearly found that paranoia was increased in their general population sample when there was a history of CSA, using the GPTS-B (Green et al., 2008), a trait measure of persecutory ideation. However, when paranoia was elicited and assessed through a state measure of paranoia in an experimental study using a virtual reality scenario, no association with childhood abuse was found. Whilst this may in part be because Freeman, Pugh, et al. (2008) did not investigate the impact of CSA separately from CPA, the authors note an important difference between the two measures, in that some of participants' responses on the paranoia measure may not have been unfounded and actually have been related to

past trauma experiences, whereas experimental studies clearly assess unfounded paranoia.

Importantly, most studies have not further explored the role of the child's age at the time of the abuse, or the perpetrator's identity. As an exception to this, Haj-Yahia and Tamish (2001) looked at exactly these variables in a large sample (n=652) of Palestinian university students and found that 32.4% of the variance in paranoid ideation was attributable to CSA irrespective of the child's age when the abuse took place. There was a clear association whether the perpetrator was a family member, relative or stranger. However, this and a further four out of seven studies that found an association between CSA and paranoia (Barker-Collo & Read, 2011; Breyer, Nelson, Baker Miller & Kroll, 1987; Murphy et al., 1988; Young, Harford, Kinder & Savell, 2007) employed the SCL-90-R (Derogatis, 1994) or the BSI (Derogatis, 1993), symptom checklists which include a subscale of paranoid ideation, but which could be argued to be less pure indicators of paranoia. Whilst not finding an association between CSA and paranoia when adult abuse was controlled for, Read et al. (2003) did find that 36% of those who experienced incest had paranoid delusions, suggesting that the perpetrator's relationship to the victim may be important.

In summary, there is no clear evidence that childhood sexual abuse specifically is associated with development of paranoia, and the association seems particularly weak in clinical populations. However, measures and operational definitions of paranoia and abuse used vary between studies. Whilst there are more positive associations found in non-clinical population studies, the results of Bentall's (2012) population study show the importance of controlling for comorbid symptoms such as hallucinations, as was also recently highlighted by Read (2013). Controlling for the impact of adult adversity also seems key as there is some evidence of stronger effects when there has been re-victimisation in adulthood (Read et al., 2003) and associations between CSA and paranoia may disappear once adult

abuse is controlled for (Surrey et al., 1990). However re-victimisation effects have mostly not been taken into account in studies to date. Finally, as Freeman, Pugh, et al.'s (2008) study was the only in the current review to use experimentally induced paranoia, it is not possible to say whether positive associations found using trait paranoia measures can be generalised to the experience of state paranoia elicited in 'live' situations.

3.3.2. Physical abuse

Associations between childhood physical abuse (CPA) and paranoia were investigated in 16 of the identified studies. As can be seen in Table 3, similar to childhood CSA there is considerable variety in the results. Just over half (i.e. eight) of the studies that looked separately at this association found a positive association. The association appears to be particularly strong in non-clinical population studies. One of the two studies that did not find a significant effect in a non-clinical sample was a study by Barker-Collo and Read (2011), which assessed CPA in a way that could be considered unreliable, through an open question as to whether participants had ever experienced any physical abuse.

In the above mentioned large population study by Bentall et al. (2012), respondents were asked whether they were ever severely beaten by a (step-)parent or carer before the age of 16. Physical abuse was found to be associated with paranoia as measured by the PSQ (Bebbington & Nayani, 1995) even when hallucinations, demographic variables and IQ were controlled for (OR=8.52). The authors note that the adversity measures used were conservative. The only true prospective study identified in the current review (Martin & Elmer, 1992) followed up a sample of nineteen individuals who had been severely physically abused as children as evidenced at the time of hospital admission from their injuries. Martin and Elmer (1992) found that these individuals as adults were more suspicious as

demonstrated by high scores on the relevant component of the Hostility-Guilt Inventory (Buss & Durkee, 1957). Whilst the overall quality rating of this study was not high due to a number of methodological limitations, a strength of this study is that the abuse was not assessed retrospectively.

The role of intentionality in causing harm, a core feature of persecutory ideation, was investigated in relation to paranoia as part of the BSI (Derogatis, 1993) by Murphy et al. (2010). These authors found that adolescents who sustained physical injuries that had been intentionally caused in the past, had higher levels of current paranoia than those with unintentional physical injuries such as those from traffic accidents. However, an important confound acknowledged by the authors is that causality cannot be ascertained and those with higher paranoia may have been more likely to engage in physical fights.

However, a number of studies failed to find positive associations between CPA and paranoia, including six out of nine studies within clinical populations. Several studies used the comprehensive CTQ (Bernstein & Fink, 1998; Bernstein et al., 2003). While Fisher, Appiah-Kusi and Grant (2012) found increased levels of paranoia with CPA history in a large general population sample (OR=3.15), looking at clinical population studies using the same measure of abuse, Ashcroft, Kingdon and Chadwick (2012) found no higher occurrence of CPA in patients with persecutory delusions compared to those without. Similarly, Mason et al. (2009) found no link between persecutory content and a history of CPA, and no association with CPA was found in Colins et al.'s (2009) forensic sample. Sample sizes may have been smaller for some of the clinical studies, but the forensic sample was also large. Surrey et al. (1990) did not replicate Bryer et al.'s (1987) finding of an association between CPA and paranoia in a female inpatient sample, having used a larger sample and having controlled for the effects of recent trauma by excluding these patients. In a sample of homeless adolescents, Mundy, Robertson, Robertson and Greenblatt (1990) found that intrafamilial physical abuse but not

physical attacks by strangers was associated with paranoia, suggesting that physical attacks within the family environment may be particularly damaging to trust in others.

In summary, there are mixed findings with regards to the association between CPA and paranoia. It is unclear from the current results what factors underlie the different outcomes, as studies have included large sample sizes, both narrow and broader definitions of CPA and a range of paranoia measures. It seems that there is particularly little evidence for a link between clinical paranoia and CPA, but that CPA may be associated with paranoia on a continuum in the general population without resulting in clinical psychosis. The findings by Mundy et al. (1990) suggest that perpetrator identity, i.e. whether it is a family member or a stranger, may be important in assessing the impact of CPA, and Murphy et al.'s (2010) findings highlight the role of intention to harm in the effects of physical trauma.

3.3.3 Emotional abuse and parental care

The impact of emotional abuse on persecutory delusions has received much less attention (Ashcroft et al., 2012). The CTQ (e.g. Bernstein & Fink, 1998) contains a separate subdomain for emotional abuse, including a question on whether someone was called things like 'stupid', 'ugly' or 'lazy' as a child. Read (2013) describes evidence from studies using the Parental Bonding Instrument (Parker et al., 1979), a measure of perceived parental care, in support of the association between childhood adversity and psychosis. In a study on the effects of perceived childhood parental care on psychosis, self-reported history of trauma (a composite measure of emotional, psychological, sexual and physical abuse) appeared to mediate the effect of perceived parental care (as assessed by the PBI) on psychosis, suggesting that early trauma may underlie lower perceived parental care (Janssen et al., 2005).

For purposes of the current review, experiences of threat or low parental care were also considered to be appropriately reviewed under emotional abuse, but perceived parental care was included in a separate column in Table 3.

As can be seen in Table 3, studies investigating associations between EA and paranoia seem to more consistently find associations with paranoia compared to the other types of abuse investigated, with six out of nine studies reporting a relationship across both non-clinical and clinical samples. Using the CTQ (Bernstein et al., 2003), Fisher, Appiah-Kusi and Grant (2012) found a clear link in a large non-clinical sample, and Ashcroft et al. (2012) found that patients with a diagnosis of schizophrenia who experienced persecutory delusions more often had a history of EA than those without persecutory delusions. Emotional abuse as measured by the CTQ also emerged as the main predictor in a best-fit model predicting paranoia related experiences in Colins et al.'s (2009) forensic sample. Interestingly, all three studies found such associations with EA in the absence of any associations with sexual abuse, and associations with physical neglect and physical abuse were inconsistent (i.e. only one of the three studies found an association). It thus appears that there is some specificity to the impact of childhood EA that distinguishes it from other forms of abuse.

Sample size may have played a role in studies finding no evidence of an association. Mason et al. (2009) found no link between EA and paranoid delusional content of symptoms; however he notes that the study's power was restricted due to their sample size of 50 patients. Most of the studies finding effects mentioned above did involve larger samples, although Mason et al.'s (2009) sample is not dissimilar from Ashcroft et al.'s (2012) sample (n=59). Similarly, Thompson et al. (2009) who also did not find an effect, note that their study may have been underpowered (n=30). In addition, the trauma measure they used conceptualises EA as including neglect on an 8-item scale, which may mean it was not sensitive enough to specific effects of EA. Steel et al. (2009) also did not find an association

with EA and sub-clinical schizotypal symptoms of paranoia, but similarly they assessed EA with a single question, which included neglect; they asked participants whether they were emotionally abused or neglected as a child by family members. Whilst they did provide examples, this may not have been specific enough to detect an effect. They also note that the sample was restricted to university students, and that severity was not taken into account in associations with single traumas and the latter may partly explain the lack of association with EA.

Five studies examined the role of the quality of early caregiving experiences more generally, and all found associations with paranoia. These include two studies finding associations between early memories of parental threat and paranoia in a sample of undergraduate students (Murphy, Shevlin, Adamson, Cruddas & Houston, 2012; Pinto-Gouveia, Matos, Castilho & Xavier, 2012). In addition, three studies investigated the impact of perceived early care and overprotection using the PBI (Parker et al., 1979) and found evidence of associations with paranoia both in clinical and non-clinical samples. A strength of the clinical studies is that control-groups were employed. For example, Rankin, Bentall, Hill and Kinderman (2005) found that patients with persecutory delusions reported lower childhood parental care and higher overprotection, even when controlling for depression. In this study, patients who were in remission also reported lower parental care and the authors suggest this may indicate that the perceived care ratings are not a bias as a result of current illness status. Similarly, Melo et al. (2006) found that inpatients with persecutory delusions of the 'poor me' type reported lower maternal care than a control group. Lower perceived paternal care was also found to predict paranoia on a measure of schizotypal traits (Meins, Jones, Fernyhough, Hurndall & Koronis, 2008).

In summary, it appears that there is stronger evidence for an association between emotional abuse and paranoia. A relationship seems particularly evident in non-clinical populations, but only four studies have investigated the impact of

emotional abuse in clinical populations, which limits the opportunity for making meaningful comparisons between these and non-clinical studies. However, there have been no large population studies as yet to specifically investigate the role of EA in development of paranoia. Consistent findings that childhood experiences of threat and low parental care are associated with paranoia indicate that a lack of nurturing environment including the experience of threatening or neglectful experiences may be particularly relevant to the development of paranoia.

3.3.4 Neglect

The impact of neglect has been under researched, despite its critical impact on neurodevelopment (Perry, 2002). For the purposes of the current review, physical and emotional neglect were reviewed together. Only six studies in the current review looked at the impact of neglect on paranoia separately, and all but two of these used the CTQ (Bernstein & Fink, 1998), which has a separate subdomain of neglect. Colins et al. (2009) was the only study to find a significant positive association with emotional and physical neglect in their large forensic sample. The finding of a positive trend by Ashcroft et al. (2012) was only found for emotional but not physical neglect. It could be argued that the findings by Ashcroft et al. (2012) and Colins et al. (2009) on emotional neglect are in line with the associations found between emotional abuse and paranoia. At the same time, the above described findings under 'emotional abuse' of associations between low perceived parental care and paranoia could also be considered to provide support for an association with neglect.

In summary, there are only a limited number of investigations of associations between neglect and paranoia, but from the available literature there does not appear to be a strong link between them. Given the finding of one association and one trend, there may be a relationship between neglect and paranoia in clinical

populations, but available evidence is inconclusive. However, there are particularly few studies with non-clinical populations to be able to draw clear conclusions about the relationship between paranoia and neglect within general population samples.

3.3.5 Separation experiences

The impact of early separation from caregivers has as yet received little attention in paranoia research, and no studies in the current review investigated the impact of parental death. Only Bentall et al. (2012) investigated the impact of being taken into institutional or local authority care and found a very large effect of institutional care on paranoia (OR=11.08), even when demographic variables and IQ and hallucinations were controlled for. Being taken into local authority care initially appeared to be protective, but this was explained by demographic and IQ confounds and the effect did not remain significant after controlling for these. Whilst being taken into care is likely highly correlated with having experienced abuse, the different (apparently protective) impact of being taken into local authority care suggests that there is more at play than direct impact of abuse experiences. The researchers suggest that the quality of parenting experienced by a child in a foster home may restore insecure attachment styles.

3.3.6 Bullying

Bullying was only investigated by three studies, two of which were within non-clinical populations. In a large sample of adolescent pupils, Campbell and Morrison (2007) found that paranoid ideation was increased in those who had experience of being bullied. Lopes (2011) found the same in a patient sample including adults. Patients with paranoid schizophrenia reported more experiences of bullying than those with social anxiety disorder, and victims of bullying had more paranoid thoughts held with more conviction and more distress than those who had not been bullied. However,

their measure included adult experiences of bullying, which may have been a critical confound. Childhood experience of bullying was not found to be associated with paranoia in Bentall et al.'s (2012) large and well-controlled population study where hallucinations were also controlled for. However "bullying" was selected from a list by respondents, and did not seem to have been further defined and therefore have been specific enough. The issue of causality in associations between bullying and psychotic experiences has been raised (e.g. Campbell & Morrison, 2007), as it is not clear whether bullying may also be a result of paranoid experiences.

In summary, whilst some associations have been found, there is very limited and inconclusive evidence as to whether bullying increases vulnerability to paranoid ideation.

3.4 Role of trauma frequency and severity

The issue of whether vulnerability to psychotic symptoms increases with increased exposure to adversity or more severe forms of abuse ('dose-effect' response) has often been raised (e.g. Read et al., 2005). Varese et al. (2012) suggested that it may not be the type of event but the age of exposure and cumulative trauma ("multi-victimisation") that is most strongly related to psychosis. In the current review, seven studies, four of which are non-clinical population studies, provide data addressing the question of whether there is evidence that paranoia increases with increased trauma exposure or severity.

In clinical population studies, Breyer et al. (1987) found that the experience of both CSA and CPA was associated with particularly high levels of paranoia, and the same was found for incest and CPA (Cavaiola & Schiff, 2000). In contrast, Schenkel, Spaulding, Dilillo and Silverstein (2005) found that hallucinations and delusions, but not paranoia was associated with abuse frequency or severity, raising

the issue that it may be critical to control for co-morbid symptoms of psychosis in determining whether a dose-response relationship is present.

Two out of four non-clinical studies provide evidence of a 'dose-response' relationship (Barker-Collo & Read, 2011; Bentall et al., 2012). When considering the two most highly quality rated (Bentall et al., 2012; Steel et al., 2009), an unexpected finding by Steel et al. (2009) was that multiple abuse experiences were not associated with the paranoia/suspiciousness dimension of schizotypy, despite their findings of significant associations with single types of abuse. Perhaps the most compelling evidence for a 'dose-response' relationship comes from Bentall et al.'s (2012) large population study. They found that the odds ratio for paranoia increased with exposure to a greater number of adverse experiences even after demographic confounds and IQ were controlled for, although the relationship they found was not completely linear.

In summary, evidence for a 'dose-response' relationship between childhood adversity and paranoia appears to be inconclusive, although available data is limited. The findings of Schenkel et al. (2005) suggest that controlling for co-morbid symptoms is important, and this has mostly not been done in research in this area.

3.5 Methodological limitations

There are well-known methodological limitations to much of the previous research on the links between adversity and psychosis or schizophrenia described in relevant reviews, including small sample sizes, selective and highly variable samples, variability in how abuse is defined and measured, and the often retrospective measurement of abuse (e.g. see review Morgan & Fisher, 2007). The studies included in the current review share most of the same limitations, which are summarised below.

As most of the investigations reviewed were cross-sectional in nature, causality and direct pathways cannot be inferred. There were only two prospective studies in this review where abuse or injury had been established objectively prior to measurement (Martin & Elmer, 1992; Murphy et al., 2010), but both were associated with methodological limitations as evidenced by lower quality ratings. Only three of the clinical studies included non-clinical control groups (Cavaiola & Schiff, 2000; Melo et al., 2006; Rankin et al., 2003), which precludes any comparison with the general population and therefore limits the conclusions that can be drawn as to how specifically the findings apply to those experiencing persecutory delusions.

Most studies have not controlled in their analyses for other confounding variables beyond demographic factors that are likely to impact on the development of a paranoid worldview. In particular, most do not take into account the likely impact of re-victimisation through adult abuse. Read et al. (2005) note that adult abuse can be a mediator of the relationship between childhood adversity and psychosis. In addition, the effects of other experiences of early adversity such as non-interpersonal trauma were generally not controlled for. Furthermore, few studies have included measurement of possible mediators or moderators on the pathway from abuse to paranoia, such as attachment. Similarly, Phillips, Francey, Edwards and McMurray (2012) note that the impact of the meaning attributed to the event by the individual is often ignored in research into associations between adversity and psychosis, and the same could be said to apply to paranoia research. As negative beliefs about others are central to the construct of paranoia (Freeman et al., 2002), the event appraisals seem a key variable to influence any relationship between the event and subsequent paranoia. The role of event appraisals have been investigated in PTSD research (e.g. Halligan, Michael, Clark & Ehlers, 2003); however, appraisals have not been examined by any of the studies reviewed other than in some studies looking at negative beliefs about others and self.

As mentioned previously, both definitions and measurement of abuse used have varied widely between studies, from comprehensive definitions and questionnaires to single item constructs. Importantly, most studies have not taken into account the extent, timing and severity of an individual's exposure to early adversity (Morgan & Fisher, 2007), which have been found to play a role in pathways from early adversity to psychosis (Fisher et al., 2010) and seem highly relevant variables in light of the frequent findings of a dose-response relationship between adversity and psychosis in previous research (e.g. Janssen et al., 2004; Lataster et al., 2006). Also in common with past critiques (e.g. Morgan & Fisher, 2007), the current studies with clinical populations included varied samples with different patient groups who likely differed in severity and chronicity of their difficulties casting some doubt on the comparability of the samples.

Bentall et al. (2012) acknowledged a limitation that their measure captured only relatively recent experience of paranoia and noted this as a limitation as many respondents may have experienced paranoia at times in the past. Whereas trait paranoia could be argued to be relatively stable, this could have nonetheless influenced whether associations are detected. A further limitation is that paranoid individuals are least likely to take part in research as a result of their suspicions and their level of distress (Freeman, 2007).

Importantly, Freeman (2007) also notes that many false findings may be found as in many studies do not control for co-occurring symptoms. Accordingly, Bentall et al.'s (2012) difference in findings when controlling for the effects of hallucinations shows that this seems a significant limitation of other studies in the current review. It may well be that paranoia, particularly in clinical samples, can sometimes be accounted for by the presence of hallucinations, again impacting on the reliability of the results discussed in the current review.

4. Discussion

4.1 Summary of findings

The current review was the first known systematic review of the impact of childhood adversity on paranoia. It did not find conclusive evidence of a relationship between interpersonal childhood adversity and paranoia. Whilst at first glance, a compellingly large number of studies have found positive associations, no consistent relationships were found when relationships were examined between paranoia and most specific types of adversity, in particular when outcomes in clinical and non-clinical samples were compared. No clear association was found between paranoia and childhood sexual abuse, in particular in clinical samples. Whilst the association seemed stronger in non-clinical populations, Bentall et al.'s (2012) findings suggest that controlling for the effects of hallucinations is critical, but all other studies failed to do this. There was a more consistent relationship between physical abuse and paranoia, but this applied to paranoia in the general population only. In addition, there is initial evidence from one study only of an association between parental separation and paranoia, but further research is clearly required. Similarly, there is very limited research on the impact of neglect and bullying in relation to paranoia and a need for further investigations is indicated. However, there appears to be more consistent evidence for a role of the quality of early caregiving relationships, including experience of emotional abuse, which may be a particularly important variable in the development of paranoia, as has been suggested by Ashcroft et al. (2012) in relation to persecutory delusions. Evidence of a dose-response relationship between adversity and paranoia was inconclusive.

Appraisal of the current empirical evidence base is constrained by a number of methodological limitations that apply to many of the studies, including small sample sizes, differing definitions and measurement of abuse and paranoia, and a failure of many studies to control for other key confounding variables such as the

impact of other types of adversity, re-victimisation or co-morbid symptoms. Only one large population study looking specifically at the impact of various childhood adversities on paranoia has been conducted (Bentall et al., 2012), which highlights a need for further large-scale studies. There is also a clear lack of prospective studies to address the question of whether there is an association between childhood adversity and paranoia. Conclusions from the current review should therefore be interpreted cautiously.

4.2 Integration of findings

The lack of consistent associations between specific types of childhood adversity and paranoia is in contrast to the increasingly established association between early adversity and psychosis, where a recent meta-analytic review found associations with all types of adversity but parental death, which also became significant when an outlier was removed (Varese et al., 2012). With acknowledgement of the abovementioned limitations, the conclusions of the current review support the importance of increased specificity in psychosis research, and provide tentative support for the notion that different pathways may underlie routes to paranoia versus clinical psychosis.

The findings that the effects of childhood sexual and physical abuse seemed stronger in non-clinical populations are interesting in relation to a continuum view regarding the population distribution of symptoms of psychosis (e.g. Myin-Germeys et al., 2003), including some debate around this from evidence suggesting there may be some discontinuities along the psychosis continuum (Linscott & van Os, 2010). Combs and Penn (2008) note that adverse sub-clinical paranoia may originate from adverse environmental events, and environmental factors may be particularly important in determining whether increased symptoms are found in the general population. It may be that early interpersonal adversity gives rise to

negative beliefs about other people, but not necessarily to a clinical level of psychopathology, as other factors may perhaps also be implicated in vulnerability to persecutory ideation at a clinical level. With regards to childhood sexual abuse, the lack of association found between CSA and paranoia in clinical samples is in line with suggestions based on previous research that sexual abuse may be more specifically associated with hallucinations than paranoia (Bentall & Fernyhough, 2008; Read et al., 2004).

However, the results cannot be considered conclusive, and must be interpreted tentatively as clinical studies often involved much smaller sample sizes, and due to a higher level of psychopathology, other factors likely also contribute to clinical persecutory delusions, such as the presence of hallucinations. In addition, the potential confound of participant selection bias (Freeman, 2007) likely applies more strongly to clinical participants. Barker-Collo and Read (2003) highlight the diversity of outcomes following CSA, and their review of various models of responses to abuse highlight the complexity of the pathways involved, including but not restricted to factors related to the abuse, attachment, individual (person) characteristics and how abuse is responded to by others.

4.3 The role of emotional abuse in paranoia

The findings of the current review suggest that emotional qualities of the early caregiving relationship may be a particularly important ingredient in the pathway from early adversity to paranoia. Whilst most types of early abuse can be considered to involve the experience of emotional abuse, the findings nonetheless showed some evidence of some specificity in this relationship, as associations were found in the absence of effects of sexual abuse in three studies, and associations with physical neglect and physical abuse in those three studies were inconsistent (i.e. only one of the three found an association).

The findings of a more consistent role of emotional abuse, particularly when considered together with other studies looking at the nurturing quality of early caregiving relationships, are consistent with the developmental account by Trower and Chadwick (1995), in particular regarding the proposed role of neglectful caregiving in the development of 'poor me' paranoia. The importance of a nurturing early environment was further demonstrated by the finding that the experience of institutional care was associated with paranoia. It may be that alongside the importance of threat in pathways from early adversity to paranoia (Bentall & Fernyhough, 2008) there is an impact of experience of rejection which is evident in types of emotional abuse, that is damaging even in the absence of physical features of abuse. The finding by Bentall et al. (2012) that institutional care was associated with paranoia, but local authority (noted by the authors to likely be foster) care seemed to have a protective role, is consistent with this idea. Experience of rejection is also relevant to physical abuse and bullying, types of adversity where some associations were found with paranoia.

4.4 Mechanisms from adversity to paranoia

The findings of a role of the emotional quality of early caregiving relationships is also consistent with attachment having been proposed as a mechanism through which early adversity may impact on the risk of psychosis (see Read & Gumley, 2008) and paranoia (Bentall & Fernyhough, 2008) in the context of findings of associations between insecure attachment and paranoia (e.g. Pickering et al., 2008).

An important variable to be considered is the role of perpetrator identity. While not fully consistent, several findings suggested that intra-familial abuse was particularly damaging to trust (e.g. Mundy et al., 1990), which also supports the notion that abuse by a primary caregiver may be particularly damaging through its

impact on attachment. However, to date very few studies have taken this factor into account.

To date, there are still very few investigations of variables mediating the relationship between childhood adversity and paranoia, and it is of note that these mediators have only been tested in non-clinical samples. Fisher, Appiah-Kusi and Grant (2012) extended the limited previous investigations into variables mediating associations between adversity and paranoia (Freeman & Fowler, 2009; Gracie et al., 2007), to specifically investigate this for childhood adversity. They tested whether anxiety, depression and negative self and other schemas mediated the positive associations found between paranoia and EA and CPA. Fisher, Appiah-Kusi and Grant (2012) found that 45% of the association between paranoia and EA could be attributed to the mediators, but only anxiety was a significant mediator. A much smaller percentage of the association between CPA and paranoia was explained by these mediators, and neither anxiety nor negative self-schemas were significant in these pathways. Steel et al. (2009) found that those with paranoia/suspiciousness scores had more negative self and other beliefs and increased anxiety and depression. However, they did not carry out mediational analyses of whether these mediated the relationship with trauma. In addition, there is recent evidence for a mediating role of shame (Pinto-Gouveia et al., 2012) and fear of disclosure (Murphy et al., 2012) in the pathway from childhood threat experiences to paranoia.

Fisher, Appiah-Kusi and Grant (2012) note that whilst their findings are in line with previous evidence of the role of affective and cognitive mediators, the partial mediation found in their study indicates that there could be other contributing factors that should be explored. It is likely that gene-environment interactions, which have been demonstrated in the experience of paranoia through daily life stress (Simons et al., 2009), are also relevant to the understanding of the impact of

early adversity on paranoia, just as they have been shown to be for psychosis (e.g. Kramer et al., 2012).

4.5 Clinical implications

The results of the current review suggest that pathways between childhood adversity and paranoia are not straightforward and further research is needed to elucidate what risk and protective factors determine whether individuals grow up to develop a paranoid view of others and the world. Over time, elucidating these pathways, including how pathways may differ at the extreme of the paranoia continuum, can help specify the proposed role of childhood adversity in current models of paranoia (e.g. Bentall, 1994; 2001, Freeman et al., 2002). A tentative hypothesis from the reviewed evidence on the impact of emotional abuse on paranoia is that besides experience of threat, experience of rejection may play an important role in the development of paranoia, and may need more empirical attention.

The findings indicate that clinicians should not neglect assessment of patients' experience of emotional abuse and the quality of parental relationships. Freeman et al. (2013) found that patients engaged better with therapy if they attributed their difficulties to factors that can change. Through better understanding of the pathways, therapy can be tailored appropriately to the benefit of therapeutic engagement.

4.6 Limitations

There are some limitations to the current review. In particular for studies that included data on paranoia from generic symptom checklists such as the SCL-90-R (Derogatis, 1994), the search strategy may to an extent have been biased to finding studies that had found positive associations with paranoia. It is likely that only

positive paranoia findings would be included in study abstracts and therefore picked up by the systematic search. Whilst effort was made to adjust for this bias by giving these studies a lower ranking, this bias may have resulted in the exclusion of relevant findings of negative associations using such generic symptom checklists. In addition, the results are likely to have been influenced by a general publication bias in clinical research where studies with significant findings are more likely to be published than those without (Easterbrook, Gopalan, Berlin & Matthews, 1991).

The specific focus of the current review on adverse interpersonal events was chosen due to its particular relevance to the interpersonal construct of paranoia. However, as a result no conclusions can be drawn from the current review about the role of other types of adversity and negative life events. Such events could also result in negative beliefs about the world and therefore contribute to paranoia (Freeman et al., 2002). In addition, the current review conceptualised paranoia within the framework of a psychosis continuum and excluded studies where paranoia featured as a symptom of personality disorders other than schizotypal personality disorder. However, paranoia features in other diagnostic categories such as paranoid personality disorder, which has also been associated with childhood adversity (e.g. Natsuaki, Cicchetti & Rogosch, 2009). Whilst a transdiagnostic approach to paranoia was outside the scope of the current review, a limitation of the review is that its conclusions cannot be generalised to the role of early adversity in the development of paranoia within different clinical diagnostic categories.

4.7 Directions for future research

Despite a recent increase in research specifically investigating the role of early adversity on paranoia, this area of research is still behind compared with the state of current research into associations between early adversity and psychosis. In

particular, there is a clear need for large prospective studies and improvement in methodological rigour such as the use of control groups in clinical population studies. Future research would ideally also follow general psychosis literature in investigating the impact of characteristics of abuse exposure, such as perpetrator identity, and timing, frequency and severity of the abuse (e.g. Fisher et al., 2010). In common with current limitations in psychosis research (e.g. Morgan & Fisher, 2007), future studies should control for comorbid symptoms of both psychosis or other mental health problems, as well as the impact of other types of abuse and experience of a range of adult adversity. There is a growing body of literature on the impact of adult adversity on paranoia (e.g. Murphy, Shevlin, Houston & Adamson, 2012). Research on the impact of childhood adversity could also benefit from more sophisticated biopsychosocial investigations, such as twin and adoption studies (e.g. see review van Os, Rutten & Poulton, 2008), which can pull apart different factors including genetic contributions (Rutter, Pickles, Murray & Eaves, 2001).

Importantly, the current review has highlighted a need for further research into the impact of childhood neglect, bullying and separation experiences on paranoia. In addition, to date there have been a very limited number of mediation studies, and further investigations of mediating variables, including the role of attachment in relation to the impact of specific types of adversity, is warranted. Inclusion of event appraisals (Phillips et al., 2012) will also be a meaningful contribution to the field. It will also be interesting to see whether the same or a different pattern of results is found when paranoia is investigated across diagnostic boundaries, including paranoid personality disorder.

Finally, the virtual reality study findings by Freeman, Pugh, et al. (2008) and Freeman and Fowler (2009) suggest that even whilst childhood adversity may impact on self-reported trait paranoia, the same impact may not be seen on state paranoia experienced by individuals in daily life situations. Therefore, further

research is needed to investigate the impact of childhood adversity, or insecure attachment as a proposed mechanism, on experience of state paranoia in real life situations. Virtual reality, as was used in the study by Freeman et al. (2008), would provide a highly controlled environment for such investigations.

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Part 2: Empirical Paper

Paranoia and the Role of Contingency in the Experience of Trust and Perceived Empathy in Interpersonal Encounters

Abstract

Aims: Interpersonal processes have received little attention in theoretical models of paranoia. This study aimed to investigate the role of paranoia and interpersonal contingency in the experience of trust and perceived empathy in encounters with unfamiliar others. A further aim was to explore associations with other factors, including attachment history and anxiety.

Method: Sixty-one healthy male participants with varying levels of trait paranoia entered a virtual student flat for rent and interviewed a virtual flatmate whose non-verbal responses were either contingent, or non-contingent in relation to the participant. Trust towards the avatar was assessed explicitly through self-report as well as implicitly through measurement of participants' distance from the avatar. In addition, perceived empathy was assessed, along with other variables hypothesised to influence the experience of trust.

Results: Contrary to expectations, participants high in paranoia perceived the contingent avatar as more trustworthy than the non-contingent avatar. In addition, regression analysis indicated that participants low in paranoia trusted the non-contingent avatar more. Implicit trust and perceived empathy did not differ as a function of contingency in either paranoia group. Dismissive attachment predicted greater explicit trust and perceived empathy, but reduced implicit trust as shown by a greater distance kept from the avatar.

Conclusion: The findings provide initial support for an interaction between interpersonal contingency and trait paranoia in influencing explicit trust of unfamiliar others. Results may have been influenced by the pleasant nature of the scenario, and replication is required with a more ambiguous scenario and a larger sample.

1. Introduction

1.1 Current psychological models of paranoia

Current psychological models of persecutory delusions identify a number of processes considered to be implicated in the development and maintenance of persecutory delusions, with particular emphasis on cognitive and affective factors. In addition to anomalous experiences, Freeman, Garety, Kuipers, Fowler and Bebbington (2002) suggest that emotional experiences (e.g. anxiety), beliefs about the self, others and the world, and reasoning biases are important contributing factors. Hypervigilance and avoidance in interpersonal encounters have also been demonstrated to play an important role in maintenance of anxiety disorders, (e.g. social anxiety; see review Bögels & Mansell, 2004). Freeman et al. (2002) propose that safety behaviours in paranoia can prevent disconfirmation of paranoid beliefs and maintain anxiety and paranoia. Individuals with persecutory ideation have indeed been demonstrated to use safety behaviours and to use these more often as anxiety increases, with avoidance being identified as a commonly used safety strategy in this group (Freeman, Garety & Kuipers, 2001).

More recently, negative interpersonal early life experiences have received significant attention as a factor considered relevant to understanding pathways to psychosis (for a recent meta-analysis, see Varese et al., 2012) and persecutory ideation specifically (e.g. Ashcroft, Kingdon & Chadwick, 2012). Attachment theory has been proposed as a useful framework for understanding the relationship between childhood adversity and cognitive, affective and interpersonal processes in psychosis (e.g. see reviews Berry, Barrowclough & Wearden, 2007; Read & Gumley, 2008) and insecure attachment has been found to be more prevalent in people with psychosis (Coutoure, Lecomte & Leclerc, 2007; Dozier, 1990; Tyrrell & Dozier, 1997; for a recent review see Gumley, Taylor, Schwannauer & MacBeth, 2013). More specific research on psychotic symptomatology has also demonstrated

meaningful links between both avoidant and anxious attachment and paranoid ideation (e.g. MacBeth, Schwannauer & Gumley, 2008; Pickering, Simpson & Bentall, 2008; see review Korver-Nieberg, Berry, Meijer & de Haan, 2013). For example, Berry, Barrowclough and Wearden (2008) showed an association between avoidant attachment and paranoia and found that this attachment style predicted interpersonal hostility.

Bentall, Corcoran, Howard, Blackwood and Kinderman (2001) propose that persecutory ideation may be the result of a biased attributional style, characterised by a tendency to attribute negative events to others when there is a perceived threat to self. Theory of Mind (ToM) deficits have been proposed to account for such paranoid personalising attributional bias: blame is placed on another person because situational factors are not taken into consideration (Bentall & Kinderman, 1999). ToM deficits have indeed been found to be linked to a personalising attributional bias (Kinderman, Dunbar & Bentall, 1998; Taylor & Kinderman, 2002; Randall, Corcoran, Day & Bentall, 2003) as well as persecutory ideation (Corcoran, Mercer & Frith, 1995; Corcoran, Cahill & Frith, 1997; Craig, Hatton, Craig & Bentall, 2004; Frith & Corcoran, 1996; Frith, 1992; Harrington, Langdon, Siegert & McClure, 2005; Langdon, Coltheart & Ward, 2006; Randall et al., 2003; Russell, Reynaud, Herba, Morris & Corcoran, 2006). However, much of the evidence for a personalising attributional bias comes from studies with clinical populations and these associations may not generalise to paranoia on a continuum in the general population. Indeed, McKay, Langdon and Coltheart (2005) did not find evidence of attributional biases in subclinical paranoia.

Vermisssen et al. (2008) extended previous research into associations between mentalising deficits (ToM) and paranoia, and their findings support the idea that mentalising deficits increase with increased vulnerability to psychosis. Frith (2004) has postulated that individuals with paranoid ideation 'over-mentalise' and have a tendency to attribute mental states where they are not implicated.

Mentalising deficits have been proposed as a variable that should be considered together with attachment in understanding pathways to psychosis (MacBeth, Gumley, Schwannauer & Fisher, 2011, in Korver-Nieberg et al., 2013).

1.2 Perception of contingency in paranoia

The construct of contingency is central to the concepts of classical and operant conditioning in behavioural learning theory. In learning theory terms, contingency is defined by Bouton (2007) as *'the "if-then" relationship between two events'* (p.424). He defines positive contingency as *'a situation where the probability of one event is higher if another event has occurred'* (p.429). Tarabulsky, Tessier and Kappas (1996) note that the ability to notice contingencies between events in the environment or between one's own behaviour and events in the environment allows people to predict events and direct their behaviour towards a favourable outcome. Contingency can take different forms, and contingent events can occur in the relationship between objects (e.g. stone falls on glass -> glass breaks), as well as in human interpersonal relationships (e.g. wave hand at someone -> other person waves back).

Recent studies have found evidence that persecutory ideation is associated with a tendency to overattribute contingency, and perceiving intentionality where there is none. Blakemore, Sarfati, Bazin and Decety (2003) found that patients with persecutory delusions perceived contingency between moving animate shapes when the movements were in fact random, and they were more likely to do this compared with a control group and patients without persecutory delusions. They conclude that their findings support an association between persecutory delusions and a tendency to overattribute contingency to the behaviour of others.

Fyfe, Williams, Mason and Pickup (2008) extended previous research (Blakemore et al., 2003; Russell et al., 2006) to further investigate the role of over-

mentalising and tendency to perceive connections in randomness, in vulnerability to psychosis. Using several tasks, including the 'Triangles Task' (Abell, Happé & Frith, 2000), they found that schizotypal and delusion-prone individuals were more likely to perceive associations between two triangles which moved randomly and did not interact, and delusion-proneness was associated with over-mentalising. They postulate that over-mentalising may be the result of a tendency to perceive associations when there are none.

An example of contingency in interpersonal relationships is caregiver responsiveness to the infant's behaviour, which plays an important role in early life. Contingencies in caregiver-infant interactions that are characterised by the caregiver responding sensitively, coherently and predictably to the infant's actions are considered to contribute to secure attachment (Tarabulsy et al., 1996). Fonagy, Gergely and Target (2007) propose that secure attachment and ToM thrive under parenting characterised by a tendency to attribute mental states to the infant accurately, tolerance and reflectiveness about affective states. In a meta-analysis, Dunst and Kassow (2008) found that the presence of explicit contingent responsiveness in measures of caregiver interactions was the main predictor of secure attachment of infants.

1.3 Virtual reality research in paranoia

In recent years, virtual reality has been used to investigate the experience of persecutory ideation and associated factors (e.g. Freeman et al., 2003, 2008; Freeman, Garety, Bebbington, Slater, et al., 2005; Freeman, Pugh, Vorontsova, Antley & Slater, 2010; Fornells-Ambrojo, Barker, Swapp, Slater, Antley & Freeman, 2008; Valmaggia et al., 2007). This technology has been used as it has the advantage of a controlled environment where avatars are neutral and appraisals of

them can therefore be said to be resulting from an individual's own appraisals, rather than being grounded in reality.

Paranoid ideation exists on a spectrum and is experienced by individuals in the general population (e.g. Freeman, Garety, Bebbington, Smith, et al., 2005), those with an at-risk mental state as well as in a clinical and a recovered population. Studies using virtual reality have demonstrated paranoid ideation in relation to avatars, across the spectrum. Freeman et al. (2010) used this technology and confirmed that factors theoretically related to paranoia, including the experience of emotional concerns (e.g. anxiety and worry), interpersonal sensitivity, and trauma history, were predictive of paranoid ideation across the spectrum. However, little is still known about how individuals with paranoia actually experience interpersonal encounters, and interpersonal processes associated with paranoid ideation.

1.4 Interpersonal Contingency

Interpersonal contingency can be considered to be a particularly interesting variable relevant to the experience of interpersonal encounters, as it corresponds closely with other factors demonstrated to elicit positive appraisals of others in interactions, such as mimicry. Interpersonal contingency can comprise different types of contingent events, including mimicry and synchrony. However, it is not limited to mimicry or synchrony as it also encapsulates general responsiveness to another individual's actions. See Table 1 for examples of different forms of interpersonal contingency.

Table 1. Examples of types of contingent events in interpersonal relationships.

Types of contingent events	
Mimicry	Non-mimicry
E.g. Person A moves right arm -> person B then mirrors this movement	E.g. Person A speaks -> person B nods in response
E.g. Baby smiles -> mother smiles back at baby	E.g. Baby cries -> caregiver soothes baby

There is strong evidence that interpersonal synchrony including direct mimicry of non-verbal behaviour is an automatic and important feature of interpersonal interactions (see Bailenson, Yee, Patel & Beall, 2008 for an overview). Research has demonstrated that interactional mimicry outside conscious awareness increases positive appraisal of the other (e.g. Bailenson & Yee, 2007). In a virtual reality study, Bailenson and Yee (2005) demonstrated that virtual avatars who mimicked participants' head movements were evaluated as more persuasive and more likeable than avatars whose head movements were prerecorded. They also found that participants maintained better eye gaze with the mimicking avatars and note that contingency of behaviour, rather than exact mimicry, may explain this positive effect. Bailenson et al. (2008) note that interactional synchrony has been proposed by Kendon (1970) to influence trust between individuals. Behavioural mimicry is also closely associated with the experience of empathy (Van Baaren, Decety, Dijksterhuis, van der Leij, & van Leeuwen, 2009).

In a virtual reality study, Vrijnsen, Lange, Dotsch, Wigboldus and Rinck (2010) found that the positive effect of mimicking was not experienced by a non-clinical population of socially anxious individuals. Socially anxious women did not form more positive evaluations of avatars who mimicked their movements. Vrijnsen, Lange, Dotsch, et al. (2010) hypothesised this may be due to self-focused attention or dislike of mimicking in socially anxious individuals and their data suggest that these individuals may have found this experience more aversive. Furthermore, in

another virtual reality study, Vrijssen, Lange, Becker and Rinck (2010) found that socially anxious individuals themselves do not display unintentional mimicry. They postulate that this might have implications for how positively socially anxious individuals are evaluated by others and may in fact reinforce their original concerns.

The impact of contingency in interpersonal encounters is therefore a relevant factor to explore in experimental research into paranoia, as it would be expected to be associated with positive appraisal of others in the general population, yet it can be postulated that interpersonal contingency might be both perceived and experienced differently in individuals with paranoia. In particular, through associations with adverse experiences (e.g. Bentall, Wickham, Shevlin & Varese, 2012; Fisher, Appiah-Kusi & Grant, 2012) and insecure attachment (e.g. MacBeth et al., 2008; Pickering et al., 2008) and given their tendency to overattribute contingency and intentionality (Blakemore et al., 2003; Frith, 2004; Fyfe et al., 2005), individuals with high levels of paranoia may experience all encounters as highly contingent and may not be able to accurately perceive the actual level of contingent behaviour in an interaction. As such, in contrast to individuals low in paranoia, they may not experience an expected increase in trust when interacting with an unfamiliar other displaying positive interpersonal contingency.

1.5 Study aims

The current study used a virtual reality environment where participants interacted with a virtual flatmate whose non-verbal responses were either contingent (i.e. in tune) or non-contingent in relation to the participant.

The main aim of the study was to investigate the impact of positive interpersonal contingency on the experience of trust towards unfamiliar others and perceived empathy of others in individuals across a range of trait paranoia. Appraisal of perceived empathy can be considered to relate to trust, as greater

perceived empathy may result in greater perceived trustworthiness, and both could be thought to be influenced by attachment through the level of caregiver responsiveness experienced in early experiences (Fonagy et al., 2007). Trust was measured explicitly through self-report as well as implicitly through objective measurement of distance kept from the avatar. The use of virtual reality technology allowed for precise manipulation of avatar contingency and programming of the avatar to behave in a neutral way.

A second aim of the present study was to further explore factors that were hypothesised to be associated with the experience of trust and perceived empathy in interpersonal encounters in individuals with high trait paranoia, including attachment history, overattribution of contingency, and the experience of anxiety.

As some variables associated with paranoia may not be continuously distributed across the paranoia continuum and may only be found in the extreme levels of paranoia (e.g. McKay et al., 2005), paranoia was examined both as a dichotomous variable and as a continuous variable. In dichotomous analyses, two groups with particularly high and low paranoia scores were compared. In additional analyses paranoia was examined as a continuous variable with inclusion of the full sample and scores across the paranoia continuum.

1.6 Hypotheses

The specific hypotheses of the study are:

1. There will be an interaction between paranoia and contingency in predicting explicit and implicit trust towards the virtual flatmate. For participants low in trait paranoia, a high level of avatar contingency is expected to evoke more feelings of trust towards the avatar, compared to when avatar responses are non-contingent. In contrast, participants high in trait paranoia will not

experience a difference in the level of trust towards the avatar, experiencing the same level of trust whether the avatar behaviour is highly contingent in relation to them, or non-contingent. It is expected that this interaction will also be demonstrated through the objective measure of implicit trust. Participants high in paranoia will maintain the same distance from the virtual flatmate in both contingency conditions, whereas participants low in paranoia are expected to move closer to the virtual flatmate when interacting with a contingent avatar compared to a non-contingent avatar.

2. Similarly, it is expected that perceived avatar empathy will vary in the same way as a function of paranoia and contingency. Participants low in paranoia are expected to perceive a contingent avatar as more empathic than a non-contingent avatar, whereas those at the higher end of the paranoia continuum will perceive equal levels of avatar empathy regardless of whether they are interacting with a contingent or non-contingent avatar.
3. Lower levels of explicit and implicit trust and lower perceived empathy of avatars will be associated with experience of paranoid ideation, insecure attachment, overattribution of contingency, and high negative affect prior to the encounter.

2. Method

2.1 Design

The study employed a group-comparison design with randomised assignment to Contingent versus Non-contingent conditions. Paranoia was examined in two ways, both as a dichotomous and as a continuous variable. When it was analysed as a

dichotomous variable, the design was a 2x2 group-comparison with independent variables of contingency (contingent; non-contingent) and paranoia (high; low).

2.2 Participants

Healthy male volunteers aged 18 and above were recruited via an all-student email at University College London, online advertisement and social media as well as advertisement through distribution of flyers. Exclusion criteria for participation in the virtual reality phase of the study were a history of epilepsy (due to associated potentially adverse effects of virtual reality) or mental health problems, including current experience of psychosis as indicated by a positive screen on the Psychosis Screening Questionnaire (PSQ; Bebbington & Nayani, 1995).

2.3 Sample size and power analysis

Power analyses were conducted using G*Power, assuming an effect size of $f = .34$ for the interaction effect of interest (based on Vrijssen, Lange, Dotsch et al. (2010)), an alpha of .05 and a power of .80. This yielded a sample size of 70. The achieved sample fell short of this.

2.4 Ethics

Ethical approval was obtained from the UCL Division of Psychology and Language Sciences (Appendix 2). The study was designed to be non-intrusive and non-threatening, and was expected to be a pleasant experience and to elicit minimal distress. Following completion of the online questionnaires, participants were informed that they could contact the researcher if completion of the questionnaires raised any concerns for them. Prior to taking part in the virtual reality exercise, they were informed that they could discontinue at any time.

2.5 Procedure

2.5.1 Study phases and participant selection

The study was conducted over two phases (Table 2). The first part involved a series of online questionnaires and an online task for all potential participants to complete. Following completion of the online part, eligible participants were invited by email to take part in the virtual reality stage at the Virtual Reality Lab at the Department of Computer Science.

Table 2. Overview of online and virtual reality study phases.

Online study phase	Virtual reality study phase		
	Pre-VR	VR exercise	Post-VR
Electronic consent	Written consent	Participant interviews virtual flatmate (four questions)	Completion of following measures: <i>Trust towards avatar</i>
Epilepsy check	<i>Baseline PANAS questionnaire</i>		
Demographic details (age, ethnicity, occupation)	Instructions to VR exercise	Avatar moves towards the window and invites participant to follow him	<i>Perceived avatar empathy</i>
Completion of following measures: <i>PSQ</i> <i>Paranoia Scale</i> <i>STAI</i> <i>Relationship Questionnaire</i> <i>Animations task</i>	Brief rehearsal of questions to ask the avatar Randomisation to contingent or non-contingent condition	<i>Distance between avatar and participant recorded</i>	<i>Post-VR PANAS</i> <i>Qualitative comments avatar perception</i> <i>Detection of contingency check</i> <i>Attention check</i> <i>Sense of Presence Questionnaire</i> De-brief

Note: PSQ= Psychosis Screening Questionnaire (Bebbington & Nayani, 1995); PANAS= Positive and Negative Affect Scale (Watson, Clark & Tellegen, 1988); Paranoia Scale (Fenigstein & Vanable, 1992); STAI= State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983); Relationship Questionnaire (Bartholomew & Horowitz, 1991); Animations Task (Blakemore, Sarfati, Bazin & Decety, 2003); Sense of Presence Questionnaire (Slater, Steed, McCarthy & Maringelli, 1998).

Whilst all eligible participants were eventually invited to come to the virtual reality lab, towards the end of the recruitment stage priority was given where possible to participants with higher trait paranoia scores in order to ensure an appropriate range of paranoia scores within the sample. In total, 188 participants completed the online phase and 63 participants took part in the virtual reality phase of the study. Figure 1 presents a flowchart of the participant recruitment and selection process.

2.5.2 Online study phase

Potential participants accessed the online questionnaires via a link in the study advertisement. Participants were first presented with the study information sheet (see Appendix 3) followed by the participant consent form (see Appendix 4). They then completed the online questionnaires. Next, they were automatically redirected to a website where they could complete the online Animations task (Blakemore, Sarfati, Bazin & Decety, 2003). Participants who completed the online part of the study were entered into a prize draw with a chance of winning a £25 store voucher.

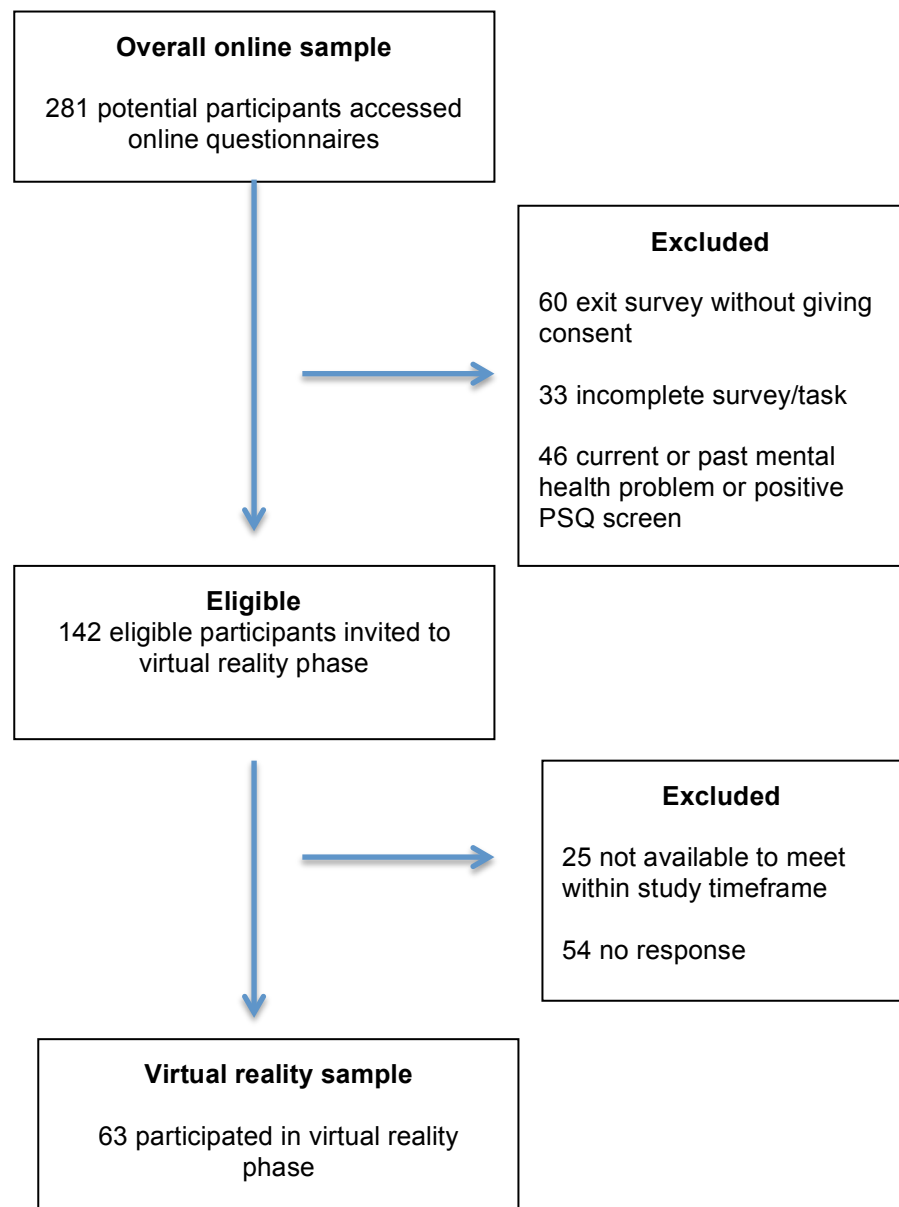


Figure 1. Flow diagram of participant recruitment.

2.5.3 Virtual reality study phase

Participants who took part in the virtual reality part of the study met with the researcher at the Virtual Reality Lab. Written consent was obtained at the start. Participants also completed a baseline PANAS (Watson, Clark & Tellegen, 1988), which measured their affect state prior to entering the virtual environment. Following this they were given instructions about the virtual reality exercise.

In order to provide a generic explanation without specifying the exact nature of the study, participants were informed that the study was interested in finding out more about how people respond to virtual environments. They were also told that the main interest of this study was to find out how the virtual character comes across to people.

Participants were informed that they would enter a virtual scenario representing a student flat which was for rent and where they would meet a virtual flatmate. Participants were instructed to interview the flatmate about his flat and were provided with a set of four questions which they were instructed to ask the avatar, in order, as part of the interview (e.g. *'What do you like about flatsharing?'*). Participants were not given further information other than that the avatar would introduce himself and may ask their name. It was emphasised that participants should ask their first question when the avatar had told them he was 'ready'. Participants were also made aware that the avatar would indicate when the interview was over. Participants were given time to try and remember the questions prior to entering the virtual scenario, and were given a prompt sheet to take with them (see Appendix 5). However, participants were instructed to try and pay as much attention as possible to the avatar and what he told them.

In order to ensure a range of paranoia scores across both conditions, prior to randomisation participants were divided into two groups based on a median split in Paranoia Scale (Fenigstein & Venable, 1992) scores. Before entering the virtual

scenario, participants were randomly allocated to either the Contingent or Non-Contingent condition by the permuted blocks method.

When participants entered the virtual reality scenario, they were instructed about the stereo glasses and were also given some direction about their starting position to ensure they started off in the line of the avatar's position. However, they were instructed to act naturally once the scenario started and were informed that they could move if they wanted, as they would in a normal interaction. A curtain was then drawn and the scenario view was 'faded in' so that it became visible to participants. When the participant confirmed they could see in 3D, the scenario was started.

Following completion of the virtual reality exercise, which lasted approximately two and a half minutes, participants completed a series of post-virtual reality measures before they were debriefed about the study. The experiment took approximately 30 minutes. All participants who participated in the virtual reality phase of the study were paid £10.

2.5.4 Apparatus¹

The VR environment was displayed in an immersive projection system, in which participants were presented with high-resolution images, projected in real-time onto three back-projected wall screens (3 m x 2.2 m) and a floor screen (3 m x 3 m). A stereo presentation of the virtual world was delivered via Lightweight CrystalEyes shutter-glasses worn by participants. These glasses presented separate images to the left and right eyes, producing the illusion of 3D objects both within and beyond the walls of the laboratory. An inertial/ultrasonic head-tracking device was mounted on the glasses, which enabled images to be presented with reference to the participants' viewpoint and orientation. This supported almost natural sensorimotor

¹ Description of the Apparatus taken and adapted where different from DClinPsy thesis by Ophelia Phillips (2012), with permission.

contingencies for visual perception meaning that as participants moved around, the environment displayed perspective-correct information. Spatialised audio was delivered via four corner speakers.

The virtual character's responses were controlled via button presses on a wireless handheld device. One button was used to cue nodding responses in the virtual character when the participant spoke, while a second button was used to cue the virtual character's next response to the participant's questions. The use of a wireless handheld device allowed the experimenter to cue responses quickly and easily as they watched each trial.

2.5.5 The virtual scenario

The virtual reality scenario represented a student flat. It was designed specifically for the current study and was programmed by collaborators at the Department of Computer Science at UCL and the University of Barcelona. The scenario was designed to be neutral, non-anxiety provoking and naturalistic (see Figure 2 for pictures of the scenario in sequence of scenario events). The flat featured a modern sitting area to the left, which was decorated to resemble a tidy living room. To the right, there was a window which looked out onto a large sunny terrace with a barbecue.

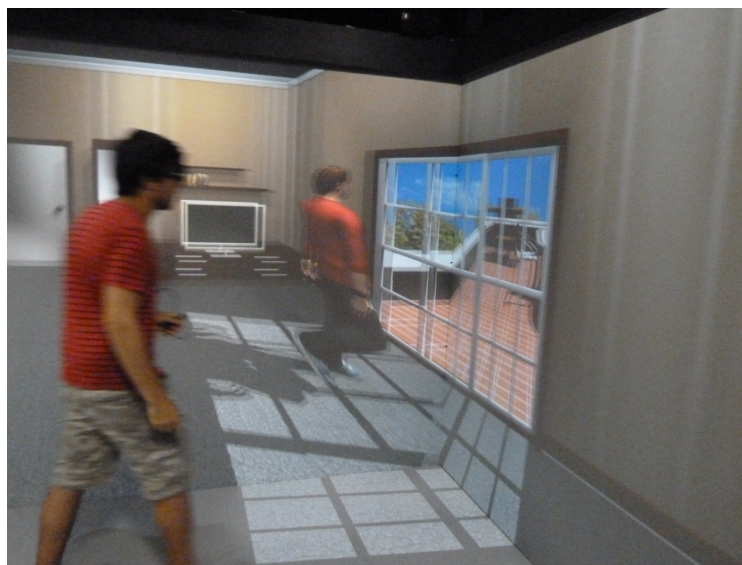
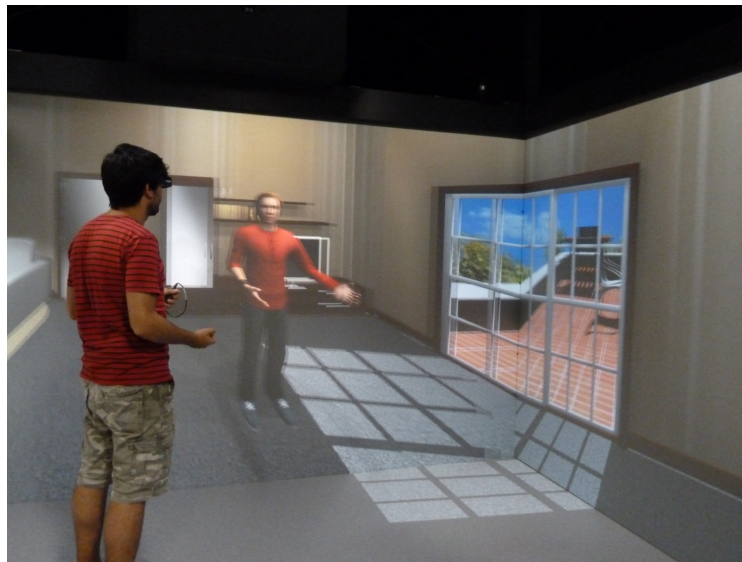
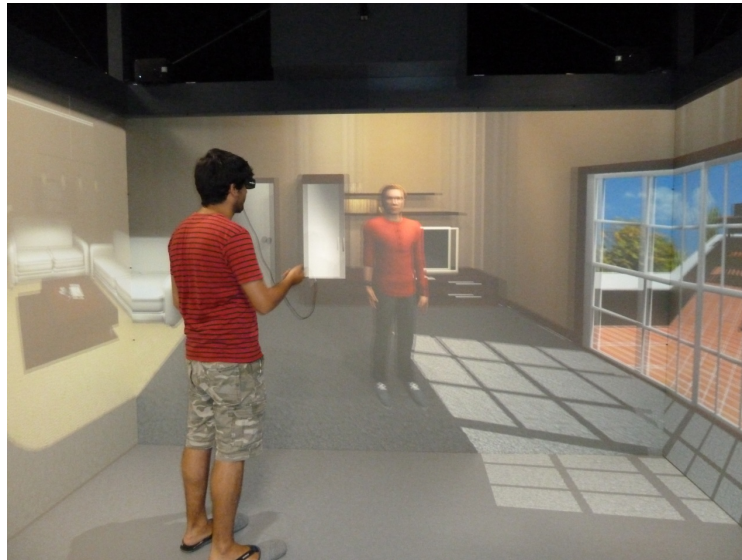


Figure 2. Pictures of the virtual scenario in sequence of scenario events.

2.5.6 The avatar

The virtual flatmate, 'Mark', was present from the start of the scenario and stood in the central area of the flat which was projected onto the back wall. Mark the avatar was designed to come across as a young, appropriately casually dressed White male in his early twenties. Mark's voice and movements were pre-recorded by a male actor and mapped onto the avatar. A head tracker worn by participants allowed programming of the avatar's gaze to always be in the direction of the participant. Mark was also programmed to blink regularly in order to make his appearance more realistic. Mark gestured with his arms during conversation and displayed subtle baseline ambient body movements throughout the scenario.

2.5.7 Contingency manipulation

The virtual flatmate's non-verbal responses to the participant were programmed to be either contingent or non-contingent with the participant. See Table 3 for an overview of the contingency mapping between participant and avatar responses in both conditions.

In the Contingent condition, the virtual flatmate subtly tilted his head every time the participant moved their head from side to side, with a 1.5 second delay. When participants moved their head in any other way, the virtual flatmate was programmed to subtly move his body either from side to side (swaying) or back and forth. In addition, in the Contingent condition Mark nodded to the participant after the participant introduced himself to the avatar as well as after every time the participant spoke to the avatar.

In contrast, in the Non-contingent condition, these same avatar responses (head tilts, body movements and nodding) were also programmed to occur, but instead with a 20 second delay. Delayed contingent responses were incorporated in the Non-contingent condition, in order to control for the effects of overall amount of

avatar movement on the dependent variables of trust and perceived empathy, as has been done using a different method in previous mimicry studies (e.g. Vrijssen, Lange, Dotsch et al., 2010). The delay of 20 seconds was chosen in order for sufficient time to have passed after the participant's response, so that the participant would not experience the avatar's response to be directly related to their own actions. Past mimicry research has indicated that detection of mimicry may adversely affect people's liking towards the other (Bailenson, Yee, Patel & Beall, 2008). Pilots were run prior to the experimental trials to ensure the two conditions were sufficiently different from one another, but were still subtle enough for the manipulations to go undetected by participants. Whilst avatar head tilts could be elicited throughout the scenario, it was not possible for avatar nodding or avatar body movements to be triggered whilst another avatar response was in the 'queue' to be elicited, or when the avatar was speaking.

Table 3. Contingency mapping participant behaviour and avatar responses.

Participant behaviour	Avatar response
Participant moves head side to side (tilt)	Avatar tilts head in the same direction and returns head to original centre after participant has done so
Participant moves head in any other direction (back/front, up/down)	Avatar moves his body (random choice of back to front or side to side (sway))
Participant speaks	Avatar nods

2.5.8 Virtual scenario script

The script consisted of 4 main parts:

- Greetings
- Participant asks and avatar responds to questions about flat sharing
- Avatar moves to the terrace and invites participant to look
- Avatar receives unexpected phone call and ends the meeting

At the start of the scenario, Mark introduced himself to the participant and asked the participant their name. He then stated that he was 'ready'. Following this cue, participants asked the virtual flatmate questions about his flat. Participants were unaware that Mark was unable to respond to any unexpected questions.

When participants asked their last question, Mark invited the participant to come and have a look at the terrace, gesturing with his arms as he spoke to the participant. See Table 4 for an extract of the conversation between the participant and the avatar. For a full overview of the scenario script, see Appendix 6. Shortly following this, Mark's mobile phone rang and Mark took the call. He turned slightly away from the participant when speaking briefly and discreetly on the phone. Mark then made his apologies to the participant and explained he had to go. He asked the participant if they could continue the interview another time, and after awaiting the participant's response the scenario was faded out manually.

Table 4. Extract from the conversation between participant and avatar.

Participant question	Avatar verbal response
<i>[Asks third question]</i>	
Who makes a good flatmate?	Mhm... Good question... don't know... I'm trying to think.... Someone who is easygoing, friendly and fun but who also can give you space. It is also good to have something in common with them, like love for sport, or music. It's hard to answer because I think it really depends on the person... I've got on with people who were completely different from me... sometimes it just works.
<i>[Asks fourth and final question]</i>	
And what would you say is the best thing about this flat?	The terrace, and the view! Come and have a look! <i>[Avatar moves to window and gazes outside before turning back to face participant].</i> It's amazing to have all this outside space, in the summer we practically live outside! We have great barbecues.

2.6 Measures

2.6.1 Online study phase questionnaires

Demographic details were collected from all recruited potential participants, including age, ethnicity, occupational details, and any history of mental health problems or epilepsy. Participants then completed the following questionnaires.

The *Psychosis Screening Questionnaire* (PSQ; Bebbington & Nayani, 1995) is a 12-item self-report measure that screens for the presence of current psychotic-like experiences in the five symptom domains of hypomania, thought insertion, paranoia, strange experiences and hallucinations. The measure includes one main screening question for each symptom domain (e.g. *'Over the past year, have there been times when you heard or saw things that other people couldn't?'*) with one or two follow-up questions each to establish whether the experience is at odds with social norms (e.g. *'Did you at any time hear voices saying quite a few words or sentences when there was no one around that might account for it?'*). Items are rated 'yes'= 1, 'unsure'= 2, or 'no'= 3. The screen was considered positive and resulted in the participant's exclusion from the study if a participant endorsed the main screening item (an answer of 'yes') and all follow-up items within one symptom domain. Participants answered all five main questions, but were not presented with follow-up questions for a symptom domain if they had indicated a negative response to the main item.

The 'trait' scale of the *State-Trait Anxiety Inventory* (STAI; Spielberger, Gorsuch, Lushene, Vagg & Jacobs, 1983) is a 20-item self-report questionnaire of trait anxiety. The scale includes negatively worded items assessing anxiety (e.g. *'I worry too much over something that really doesn't matter'*) and positively worded items, which are reverse scored (e.g. *'I am "calm, cool, and collected"'*). Participants rated

items on a four-point scale (from 1= 'Almost never' to 4= 'Almost always') based on how they 'generally feel'. Total scores range from 20-100, and higher scores indicate a higher level of trait anxiety. The STAI has good internal consistency, satisfactory test-retest reliability and good construct and concurrent validity (Spielberger, 1983; 1989).

The *Paranoia Scale* (PS; Fenigstein & Vanable, 1992) is a self-report measure of trait paranoia consisting of 20 items, which include both ideas of reference (e.g. *'I have often felt that strangers were looking at me critically'*) and persecution (e.g. *'Someone has it in for me'*). Items are rated on a five-point scale from 1= 'Not at all applicable to me' to 5= 'Extremely applicable to me', with a minimum score of 20 and a maximum score of 100. Higher scores indicate greater paranoid ideation. Originally designed to measure paranoia in college students, it is the most widely used measure of paranoia and has good internal reliability, test-retest reliability and convergent validity (Freeman, 2008).

The *Relationship Questionnaire* (RQ; Bartholomew & Horowitz, 1991, Appendix 7) is a brief self-report measure of attachment. Participants indicated which of four descriptions of relationship styles best described their general relationship style. In addition, they rated on a 7-item point scale (from 1= Not at all like me' to 7= 'Very much like me') how well each of the four styles matched their own general relationship style. One relationship style describes a secure attachment style (*'It is easy for me to become emotionally close to others. I am comfortable depending on them and having them depend on me. I don't worry about being alone or having others not accept me.'*). The other three relate to insecure attachment of the 'fearful', 'dismissive', and 'preoccupied' types. Participants' attachment ratings rather than the categorical selections are considered to be the most appropriate use of the scale whilst the descriptions with forced categorical choice is important as

they have a counterbalancing role (Bartholomew, n.d.). The RQ has good construct, convergent and discriminant validity (Griffin & Bartholomew, 1994).

The *Animations task* (Blakemore, Sarfati, Bazin & Decety, 2003, Appendix 8 for stimuli example) was administered manually in previous research (e.g. Blakemore et al., 2003); however for the purposes of the current study it was programmed so it could be accessed and completed by participants online. This task provides a measure of the extent to which participants overattribute contingency. Participants were presented with a series of brief animations on a computer screen, which show two shapes ('Prime Mover' and 'Reactive Mover'). They were asked to indicate whether in their opinion, there was a relationship (direct or indirect) between the movements of the shapes. A 'contingency rating' is obtained by asking participants to rate the strength of the relationship between the two shapes on a scale from 0-10.

The task has four conditions in which the level of contingency between two moving shapes differs. In 'Animate' animations, the Reactive Mover moved on its own accord, whereas in 'Inanimate' animations it did not move by itself. In the Animate contingent condition, the Reactive mover only moved when the other shape became visible to it, whereas in the non-contingent condition it moved when this was not yet the case. In the Inanimate contingent condition, the Prime mover bumped the Reactive Mover, but in the non-contingent condition it passed it without touching. Overattribution of contingency is inferred when participants rate the relationship between shapes in the non-contingent condition as stronger than those in the contingent conditions. Blakemore et al. (2003) found this to occur in patients with paranoid delusions for Animate animations only.

Participants were presented with four sample animations and 20 experimental animations. Animations were presented in random order and as in Blakemore et al. (2003) the colour and form of the shapes, the Prime Mover's exit points and direction of motion were varied. In contrast to previous studies, a single

rather than double presentation of each animation was considered sufficient given that the study employed healthy volunteers. Instructions were identical to those used by Blakemore et al. (2003) but were presented on-screen.

2.6.2 Pre-virtual reality questionnaire

Participants were asked to complete the *Positive and Negative Affect Scale* (PANAS; Watson, Clark & Tellegen, 1988) prior to entering the virtual environment. The PANAS is a 20-item self-report questionnaire that assesses positive and negative emotions experiences and results in two separate subscales for positive and negative affect. Participants rate the extent to which each word applies to how they feel (e.g. *'jittery'*) on a 5-point scale from 1= 'Very slightly or not at all' to 5= 'Extremely'. The PANAS has good reliability and validity (Crawford & Henry, 2004). For the purposes of the current study, participants were asked about how they felt 'right at this present moment'. This questionnaire was repeated following the virtual reality exercise to assess any changes in positive or negative emotions experienced by participants as a result of their experience of the virtual scenario.

2.6.3 Virtual reality measure

Distance kept from the avatar. The distance participants kept from the avatar was automatically recorded (in metres) throughout the participant's time in the virtual environment. The mean distance kept by the participant from the avatar during the scene when the avatar has invited them to come and have a look at the terrace was used as an objective behavioural indication of trust. At each animation frame, the 3D positions of both the virtual character's head and participant's head were recorded. The distance between the avatar and the participant was measured as the horizontal Pythagorean distance (i.e. the distance calculation ignored any

difference between the height of the virtual character and the height of the participant).

2.6.4 Post-virtual reality questionnaires

Avatar Trustworthiness. Participants' feelings of trust towards the avatar were assessed with a Likert-scale item. Participants rated on a 7-point scale (from 1= 'Not at all' to 7= 'Very much') how trustworthy Mark the virtual flatmate came across ('In relation to the avatar, what were your impressions of Mark, the virtual flatmate?'. 'How trustworthy did he come across?').

Perceived avatar empathy (Modified version of the Empathic Understanding subscale, Barrett-Lennard Relationship Inventory; Barrett-Lennard, 1978, Appendix 9). The Empathic understanding subscale of the Barrett-Lennard Relationship Inventory is a 16-item self-report questionnaire assessing perceived empathy from another (specified) individual towards the self. The scale was modified for the current study. Items were preceded by '*I felt that Mark the avatar was the type of person who would...*' in order to be somewhat more tentative in light of the limited time participants had spent with the flatmate during the brief interaction (e.g. I felt that Mark was the was the type of person who would...*want to understand how I see things*'). Following previous studies using a modified version of a subscale from this relationship inventory (e.g. Pistrang & Barker, 1992), the original rating scale from +3 to -3 was changed to a rating scale from 1-6. Higher scores reflected a higher level of perceived empathy.

Scenario feedback and checks: detection of avatar contingency (see Appendix 10). In order to ascertain whether participants had consciously perceived the contingency in the avatar's head tilts and nodding, participants were asked whether

they had noticed any relationship between what they did and the virtual flatmate's actions (yes or no). Participants who did perceive a relationship were asked to write down what they had noticed. As a check to confirm that participants had directed sufficient attention to the avatar during the virtual interaction, participants were asked to answer two 'true or false' questions about what the avatar had told them during the conversation about flatsharing. Participants were also asked by the researcher for some qualitative verbal comments on what they thought of the virtual flatmate.

The *Sense of presence questionnaire* (Slater, Steed, McCarthy & Maringelli, 1998, Appendix 11) is a 6-item self-report measure assessing the extent to which participants felt present in the virtual world, as opposed to their physical location (e.g. *'During the experience, which was strongest on the whole, your sense of being in the virtual flat, or being in the real world of the laboratory?'*). Participants rate items on a 7-point scale and a higher score indicates a greater sense of presence in the virtual flat.

2.7 Analysis

All data was analysed using SPSS for Mac (Version 21). The following analyses were conducted to assess the study's hypotheses.

2.7.1 Paranoia groups

In order to assess the effects of paranoia, paranoia was examined both as a dichotomous variable and as a continuous variable. For analyses conceptualising paranoia as a dichotomous variable, two groups were created to include only participants with Paranoia Scale (Fenigstein & Venable, 1992) scores falling in the

top 20% (high paranoia group) and bottom 20% (low paranoia group), respectively. This cut-off percentage was considered appropriate both in light of a priori intentions and in comparison to other cut-offs used in previous research. Using the Paranoia Scale, Combs, Michael and Penn (2006) used a cut-off of 1 standard deviation above and below the mean reported by Fenigstein & Venable (1992) to create high and low paranoia groups. Whilst their high paranoia cut-off score was somewhat higher than in the current study, the current sample cut-offs of 20% were close to one standard deviation above and below the current study's sample mean.

2.7.2 Animations task

In line with Blakemore et al.'s (2003), participants' tendency to overattribute contingency was calculated by comparing participants' ratings of the relationship between the two shapes in the animate contingent (AC) condition with their ratings of this relationship in the non-contingent animate condition (AN). Overattribution of contingency was coded categorically as '1=yes' versus '0=no' for each participant who rated the relationship between the two shapes in the non-contingent animate condition as equally strong or stronger than in the contingent condition (i.e. an AC-AN score of equal to or greater than zero).

2.7.3 Affect change

In order to assess the impact of the virtual scenario on participants' affect states, differences between baseline and post-VR positive and negative affect scores as measured by the PANAS were assessed with two related-samples Wilcoxon t-tests.

2.7.4 Dichotomous group analyses

Three 2x2 univariate ANOVA's were conducted to assess whether paranoia level (High; Low) interacted with contingency condition (Contingent; Non-contingent) in

predicting trust towards the avatar, perceived avatar empathy and distance kept from the avatar by participants after the avatar had asked them to come and look at the terrace. Follow-up t-tests were conducted where appropriate.

2.7.5 Continuous analyses

Hierarchical regression analyses were conducted to assess whether paranoia (as a continuous variable), contingency condition and their interaction, as well as other predictor variables considered theoretically relevant to the dependent variables, predicted trust towards the avatar, perceived avatar empathy and distance kept from the avatar.

3. Results

3.1 Sample demographics

Sixty-three participants took part in the virtual reality stage of the study. Data from two participants was excluded from analysis due to unexpected technical faults during the running of the virtual scenario, which were considered to have significantly impacted on the participant's experience of the scenario. The final sample included 61 males with a mean age of 25.3 (SD= 7.3). The majority of the sample described their ethnicity as White British or White other (77%, n=47), 13% as Asian or Asian British (n=8) and 8% as Mixed or Other (n=5). The sample included predominantly undergraduate and postgraduate students (90%, n=55). The remaining participants were in part-time employment (8%, n=5) or full-time employment (2%, n=1).

3.2 Data screening

3.2.1 Missing data

There were missing values on the post-VR PANAS and Trust measure, however on both occasions this was only the case for one out of 61 cases. Data from one participant on the Animations task was missing. There was one missing item on the baseline PANAS measure for one participant and one double response for another item on this measure for the same participant. The more conservative lower of the double score was chosen for both the missing and double scored item to correct for this. Data from the first five participants on the adapted Empathic Understanding subscale (perceived empathy) could not be included in the analyses as the scale was amended following initial participant feedback.

3.2.2 Normality of distributions

All data was screened for normality and outliers. Inspection of histograms and significance levels on the Kolmogorov-Smirnov test indicated that scores on the Paranoia Scale (PS), baseline and post-VR negative PANAS scores, ratings for all attachment categories and trustworthiness scores were not normally distributed. Scores on trait anxiety, perceived empathy as well as the distance kept from the avatar were all normally distributed.

Baseline and post-VR negative affect PANAS scores were significantly positively skewed. In addition, there was one outlier on the baseline negative affect PANAS, and three outliers on the post-VR negative affect PANAS. However, as all outliers were in the general direction of the data, scores from these participants were retained in the data. Log, square root and reciprocal transformations were applied in an attempt to normalise the data distribution. However, none of these transformations resolved the positive skew. The original data was therefore used in

analyses and non-parametric tests were employed for comparisons of baseline and post-VR PANAS scores.

Whilst Paranoia Scale (PS) scores were positively skewed, no transformation was applied to this variable. Transforming the PS scores may have altered the values towards the extremes of the distribution and therefore compromised the ANOVA analyses where paranoia was examined as a dichotomous variable, as well as impacted on interpretability of the findings. In addition, inspection of the regression residuals plots of the final regression models confirmed normal distribution (or close enough approximations to this) of trustworthiness and perceived empathy. This was also considered a reasonable justification for not transforming trustworthiness and attachment scores, single-item Likert scale ratings which were not expected to be normally distributed.

3.2.3 Regression assumptions

Durbin-Watson test statistics for all three regression analyses were considered to be close enough to the value of 2 to assume that the assumption of independent residual terms was not violated. Inspection of the residual plots indicated that the assumption of heteroschedasticity was also not violated in any of the regression models.

3.3 Pre-VR measures

3.3.1 Paranoia, trait anxiety and attachment by paranoia group

Table 5 shows the descriptive statistics for all predictor variables completed by participants prior to the virtual reality exercise (except baseline PANAS scores), for the entire sample as well by paranoia group. Paranoia Scale (Fenigstein & Vanable, 1992) scores for the whole sample ranged widely (22-63) with a mean of

35.57 (SD=10.98). Similar to the mean score for this measure in a non-clinical population found by Freeman et al. (2003), the mean of the current study was lower than the mean of 42.7 found by Fenigstein and Venable (1992) in a college sample. Using the bottom 20% and top 20% as cut-off percentiles for the low and high paranoia groups respectively, Paranoia Scale scores in the low paranoia group ranged from 22-26, compared to 45-63 in the high paranoia group.

Two-tailed Mann-Whitney independent samples t-tests were conducted to assess group differences between participants high and low in paranoia on all pre-VR measures. Participants high in paranoia scored significantly higher on trait anxiety, as well as on fearful and preoccupied attachment than those with low paranoia scores.

Table 5. Group comparison of Pre-virtual reality measures.

	Entire sample (n=61)		Low paranoia (n=12)		High Paranoia (n=18)		z	p ^a
	Mean	SD	Mean	SD	Mean	SD		
Paranoia (PS)	35.57	10.98	24.33	1.68	53.0	5.88	-4.61	<.001***
Trait anxiety (STAI)	38.15	8.83	34.0	7.95	43.83	8.07	-2.78	.002**
Secure attachment (RQ)	4.85	1.55	5.33	1.14	4.25	1.82	-1.61	.055
Fearful attachment (RQ)	3.16	1.82	2.61	1.88	4.50	1.88	-2.47	.008**
Preoccupied attachment (RQ)	2.69	1.83	2.06	1.86	3.75	2.01	-2.88	.002**
Dismissive attachment (RQ)	3.84	1.63	3.50	1.69	4.0	1.21	-0.79	.223

Note: * p< .05; ** p< .01, *** p< .001

^a p values relate to comparisons high and low paranoia group differences with Mann-Whitney one-tailed t-tests (exact significance levels due to small sample sizes).

PS= *Paranoia Scale* (Fenigstein & Vanable, 1992); STAI = *State-Trait Anxiety Inventory* (Spielberger et al., 1983); RQ= *Relationship Questionnaire* (Bartholomew & Horowitz, 1991).

3.3.2 Animations task

In the high paranoia group (n=11), three participants were considered to have overattributed contingency on the Animations task, compared with two participants in the low paranoia group (n=18). Due to the small sample sizes, two of the expected frequencies were smaller than 5 and the assumption for chi-square was not met. Fisher's exact test was therefore used to assess whether participants high in paranoia overattributed contingency more than those low in paranoia.

In contrast to the finding by Blakemore et al. (2003) that participants with persecutory delusions overattributed contingency (perceiving contingency in animate non-contingent animations), Fisher's exact test indicated that non-clinical

participants high in paranoia did not overattribute contingency on the Animations task (Blakemore et al. 2003) significantly more often than participants in the low paranoia group ($p = .266$; one-sided).

When comparing the two paranoia groups using exact mean AC-AN ratings, a continuous rather than dichotomous measure of contingency attributions on the Animations task, results of a Mann-Whitney independent samples t-test (exact significance one-tailed due to small sample sizes) also confirmed that there was no significant difference between the low paranoia group ($Mdn = 2.1$) and the high paranoia group ($Mdn = 1.8$) in participants' comparative relationship ratings in AC and AN ($U = 85.5$, $z = -0.61$, $p = .278$).

3.4 Affect change following virtual reality scenario

Mann-Whitney independent samples two tailed tests comparing baseline and post-VR PANAS scores between high and low paranoia groups (using exact significance level due to small sample sizes) indicate that PANAS ratings did not differ for participants high or low in paranoia, either for baseline positive affect ($z = -0.53$, $p = .608$), baseline negative affect ($z = -1.43$, $p = .162$) post-VR positive affect ($z = -0.17$, $p = .876$), or post-VR negative affect ($z = -0.91$, $p = .379$).

However, comparison of baseline and post-VR affect showed group differences in affect change following the virtual scenario. Table 6 presents descriptive data for the baseline and post-VR PANAS scores for the entire sample as well as comparisons by paranoia group. Wilcoxon two-tailed related samples tests were conducted to assess whether PANAS negative and positive affect scores had changed from baseline levels following participants' experience of the virtual scenario. These tests indicated that across the full sample, experience of the virtual scenario resulted in a reduction in negative affect. Further exploration showed that only those high in paranoia experienced a reduction in negative affect, whereas

participants low in paranoia actually experienced a reduction in positive affect without a significant reduction in negative affect.

Table 6. Baseline and post-VR PANAS data and comparisons by paranoia group.

	Baseline positive affect	Post-VR positive affect			Baseline negative affect	Post-VR negative affect		
	Mean (SD)	Mean (SD)	<i>z</i>	<i>p</i> ^a	Mean (SD)	Mean (SD)	<i>z</i>	<i>p</i> ^a
Entire sample (<i>n</i> =61) ^b	30.80 (6.55)	29.70 (7.08)	-1.91	.056	12.25 (2.60)	11.81 (2.84)	-2.29	.022*
Low paranoia (<i>n</i> =18)	31.67 (8.15)	30.00 (9.13)	-2.03	.040*	11.67 (1.41)	11.39 (2.38)	-0.89	.398
High paranoia (<i>n</i> =12)	31.17 (5.13)	31.42 (4.81)	-0.10	.947	13.25	11.92	-2.14	.045*

Note: * *p* < .05; ** *p* < .01, *** *p* < .001

^a For comparisons in low and high paranoia comparisons, exact significance due to low sample sizes.

^b *n* = 60 for post-VR PANAS scores.

3.5 Sense of presence, attention and contingency perception checks

Participants' mean score of their sense of presence in the virtual scenario (25.47, SD=6.52, range= 11-38) was similar to the non-clinical group mean (23.7) found by Fornells-Ambrojo et al. (2008) in their study using a virtual tube scenario. Many participants commented on how realistic they had found the virtual scenario or noted elements that had made it less realistic. The avatar also was reported to be realistic, eliciting a wide range of personal avatar attributions (e.g. comments that he seemed "very friendly", "like a typical flatmate", appeared "anxious", or was rude to take the phone call.

Post-VR responses to the two true or false questions about the content of what the avatar had told them, which had been included in order to check whether participants had paid attention to the actual interaction, indicated that the majority of all participants had paid good attention to the virtual avatar and the conversation. Only six (9.8%) had answered one or both of the questions incorrectly.

In the contingent condition, post-VR responses to the contingency perception check indicated that ten (33.3%) participants might have detected the contingency relationship whereas three (4.9%) of the participants in the non-contingent condition reported to have noticed a contingent relationship (Fisher's Exact test $\chi^2=4.50$, $p= .034$). However, further inspection to verbatim responses suggested that only three of these comments clearly confirmed detection of the contingency, and the other responses were less specific or ambiguous (e.g. *"He appeared to roughly maintain eye contact as I moved my head"*; *"There was a response to some of my body language"*), indicating possible but not definite detection of the contingency. There was no difference between the low and high paranoia groups in the number of participants who may have detected the contingency².

3.6 Dichotomous paranoia group analyses

Correlational analyses of the relationships between the main outcome variables showed that trust was significantly correlated with perceived empathy ($r= .58$, $p< .001$). Implicit trust, as assessed by the mean distance kept by the participant was not significantly correlated with either trust ($r= -.05$, $p= .734$) or perceived empathy ($r= -.11$, $p= .418$).

² Contingent condition: In the low paranoia group 3/9 (33%) might have noticed the contingency and 6/9 (67%) did not. In the high paranoia group 3/7 (43%) noticed the contingency and 4/7 (57%) did not. Non-contingent condition: Only one participant in both the low paranoia group ($n=5$) and high paranoia group ($n=9$) reported to have noticed a contingency.

Descriptive statistics of the main post-VR outcome variables by paranoia group and contingency condition are presented in Table 7. This section reports analyses in which paranoia was treated as a dichotomous variable so only participants whose paranoia scores fell in the high and low paranoia groups were included and compared.

Table 7. Post-VR measures by contingency condition and paranoia group.

	Entire sample		Low Paranoia		High Paranoia	
	NC ^a (n=30)	C ^b (n=31)	NC ^c (n=9)	C ^d (n=9)	NC (n=5)	C ^e (n=7)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Trust	4.76 (1.22)	4.97 (0.91)	4.89 (1.05)	4.67 (1.23)	4.0 (1.23)	5.43 (0.54)
Perceived empathy	56.75 (7.67)	53.89 (10.05)	58.43 (7.19)	51.71 (12.98)	51.40 (7.34)	57.00 (10.88)
Mean distance kept from avatar at window	1.44 (0.27)	1.42 (0.27)	1.37 (0.20)	1.35 (0.24)	1.62 (0.34)	1.35 (0.30)

Note: ^a: n= 29 for Trust, n= 28 for Perceived empathy; ^b: n= 28 for Perceived empathy; ^c: n= 7 for Perceived empathy; ^d: n= 7 for Perceived empathy; ^e: n= 6 for Perceived empathy.

3.6.1 Explicit trust towards the avatar

It was hypothesised that for participants low in trait paranoia, a high level of avatar contingency would evoke more feelings of trust compared to when avatar responses were non-contingent. In contrast, participants high in trait paranoia were expected to experience the same level of trust, whether the avatar behaviour was highly contingent in relation to them, or non-contingent.

There was no main effect of Paranoia category ($F(1,29)= 0.03$, $p= .873$) or Contingency ($F(1,29)= 2.34$, $p= .138$) on trust, indicating that when considered independently, trustworthiness ratings did not differ across paranoia groups or contingency conditions. There was a significant interaction between Paranoia and Contingency ($F(1,29)= 4.38$, $p= .046$); however, this effect was in the opposite direction from what had been hypothesised (see Figure 3). Participants high in paranoia perceived the avatar as more trustworthy in the Contingent condition ($M= 5.43$) than in the Non-contingent condition ($M= 4.0$): $t(10)= 2.78$, $p= .020$. In contrast, participants low in paranoia perceived the avatar as equally trustworthy in both the Contingent ($M= 4.67$) and Non-contingent condition ($M= 4.89$): $t(16)= -0.41$, $p= .685$.

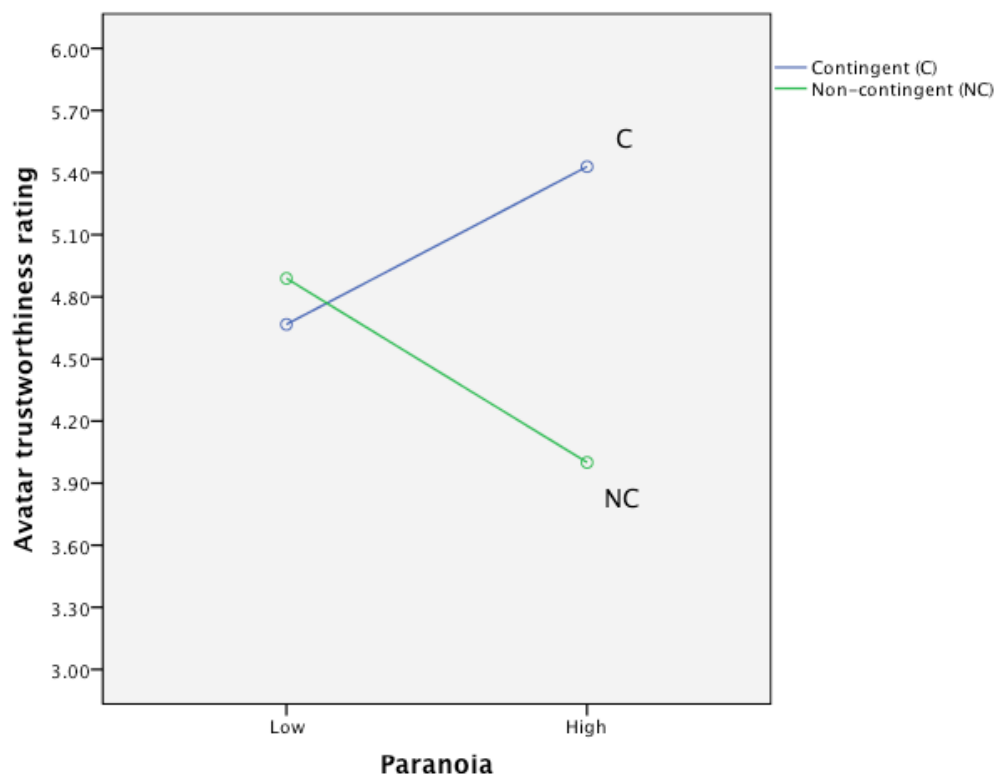


Figure 3. Avatar trustworthiness rating by Paranoia category and Contingency condition.

3.6.2 Implicit trust towards the avatar (distance kept)

The mean distance kept from the avatar by participants after the avatar had invited them to look at the window was considered to be an objective and implicit marker of trust. It was therefore expected that there would also be an interaction between paranoia and contingency condition in predicting distance kept from the avatar during this 'window scene'. Participants high in paranoia were expected to keep equal distance from the avatar in both contingency conditions, whereas participants low in paranoia were expected to move closer to the avatar in the contingent condition compared to the non-contingent condition.

As participants' baseline distance between the participant and the avatar may have been influenced by instructions received at the start of the scenario and also may have impacted on the distance participants had to walk to move to the window (therefore possibly influencing the distance they kept during the window scene), the mean baseline distance between the participant and the avatar was entered as a covariate in the ANOVA in order to control for this variable.

Contrary to the hypothesis, there was no significant interaction effect between Paranoia and Contingency on mean distance kept by participants from the avatar during the window scene ($F(1,29) = 0.69$, $p = .415$), indicating that the distance participants kept from the avatar in either contingency condition did not vary as a result of high or low paranoia status. However, there was a near significant main effect of Contingency ($F(1,29) = 4.03$, $p = .056$), indicating that there was a trend across participants experiencing a non-contingent avatar to keep more distance from the avatar than participants who experienced a contingent avatar. There was also a near significant main effect of Mean Baseline Distance ($F(1,29) = 3.95$, $p = .058$), indicating that the distance participants kept at the start of the scenario influenced the distance they kept when the avatar invited them to see the terrace, across both contingency conditions and levels of paranoia. There was no

main effect of Paranoia ($F(1,29) = 3.11, p = .09$). The distance kept from the avatar did not differ systematically between participants high or low in paranoia.

3.6.3 Perceived empathy

It was hypothesised that there would also be an interaction between paranoia and contingency condition in predicting perceived avatar empathy. Participants low in paranoia were expected to perceive a higher level of avatar empathy in the contingent condition than in the non-contingent condition, whereas it was predicted that participants high in paranoia would perceive a similar level of empathy regardless of avatar contingency.

There were no main effects of Paranoia ($F(1,24) = .046, p = .832$) or Contingency on perceived avatar empathy, ($F(1,24) = .019, p = .892$). In contrast to the hypothesis, there was also no interaction effect ($F(1,24) = 2.29, p = .145$). Participants did not perceive greater avatar empathy regardless of their paranoia status or whether they experienced a contingent or non-contingent avatar.

3.7 Paranoia continuum analyses

A second set of analyses was conducted in which paranoia was treated as a continuous variable and the whole sample was included. Three two-stage hierarchical regression analyses were conducted in order to assess the relative predictive value of all the relevant independent variables on explicit and implicit trust towards the avatar, and perceived avatar empathy.

The variables theoretically central to the study hypotheses, paranoia (as a continuous variable), contingency and their interaction, were included in stage one. In addition, trait anxiety was entered simultaneously in order to control for any effects of this variable that may otherwise be attributed to paranoia. When mean distance from the avatar was the dependent variable, mean baseline distance was

also entered as a control variable. Other independent variables known to be theoretically associated with paranoia and considered to be possible mechanisms through which paranoia may impact on the experience of avatar contingency were entered together in the second stage. Respectively, these included baseline PANAS negative affect scores, a tendency to overattribute contingency (measured categorically as yes or no as indicated by participants' scores on the Animations task) and participants' Relationship Questionnaire attachment ratings for all four categories (secure, fearful, preoccupied and dismissive). These were entered in a separate step in order to assess whether any effects of an interaction between paranoia and contingency remained after including these variables and to assess their own contributions to predicting explicit trust, implicit trust and perceived empathy in a full model.

3.7.1 Predictors of trust

It was predicted that explicit trust towards the avatar would be predicted by an interaction between paranoia and contingency condition, insecure attachment, a tendency to overattribute contingency and high negative affect at the start of the encounter.

In the final model (step 2, see Table 8) and in line with the hypothesis, the interaction between paranoia and contingency condition, baseline negative affect and dismissive attachment ratings significantly predicted trust towards the avatar ($R^2 = .34$, $F(10,48) = 2.47$, $p = .018$), even when controlling for trait anxiety.

In addition, the regression analysis confirmed the role of negative affect and attachment in predicting trust towards the avatar and demonstrates that these effects exist independent of other effects. However, these effects were again in the opposite direction from what was expected. Participants with higher negative affect at the start of the virtual scenario trusted the avatar more than those who

experienced less negative affect. Similarly, whilst secure, fearful and preoccupied attachment did not significantly predict trust towards the avatar, participants with high dismissive attachment ratings trusted the avatar more. The regression analysis indicates that a tendency to overattribute contingency as measured by the Animations task did not contribute to avatar trust.

The regression analysis confirmed the presence of an interaction effect found through the ANOVA, when paranoia is examined as a continuous variable. Whilst the paranoia and contingency interaction was a significant predictor when considered independently from the additional predictor variables, the initial model incorporating this interaction effect whilst controlling for trait anxiety only explained 10% of the variance and was not significant ($p = .215$). However, when adding other independent variables considered to be theoretically relevant with regards to predicting trust towards the avatar, the interaction effect and the overall model became highly significant and the overall model explained a good proportion of the variance ($R^2 = .34$).

In order to further examine the direction of the interaction effect within the regression model where paranoia was examined as a continuous variable, a follow-up interaction probe was conducted using the Johnson-Neyman technique by running the SPSS MODPROBE macro by Hayes and Matthes (2009), which allows for visual inspection of moderator significance regions. This regression probe confirmed that participants high in paranoia ($PS > 44.08$) trusted the contingent avatar significantly more than the non-contingent avatar. However, the probe also demonstrated that when taking the final full model into consideration, at the low extreme of paranoia, the opposite effect was found. Participants at the lower end of the paranoia continuum ($PS < 28.17$) actually trusted the non-contingent avatar more than the contingent avatar. Participants with paranoia scores outside of these extremes trusted the avatar equally across both conditions (see Figure 4).

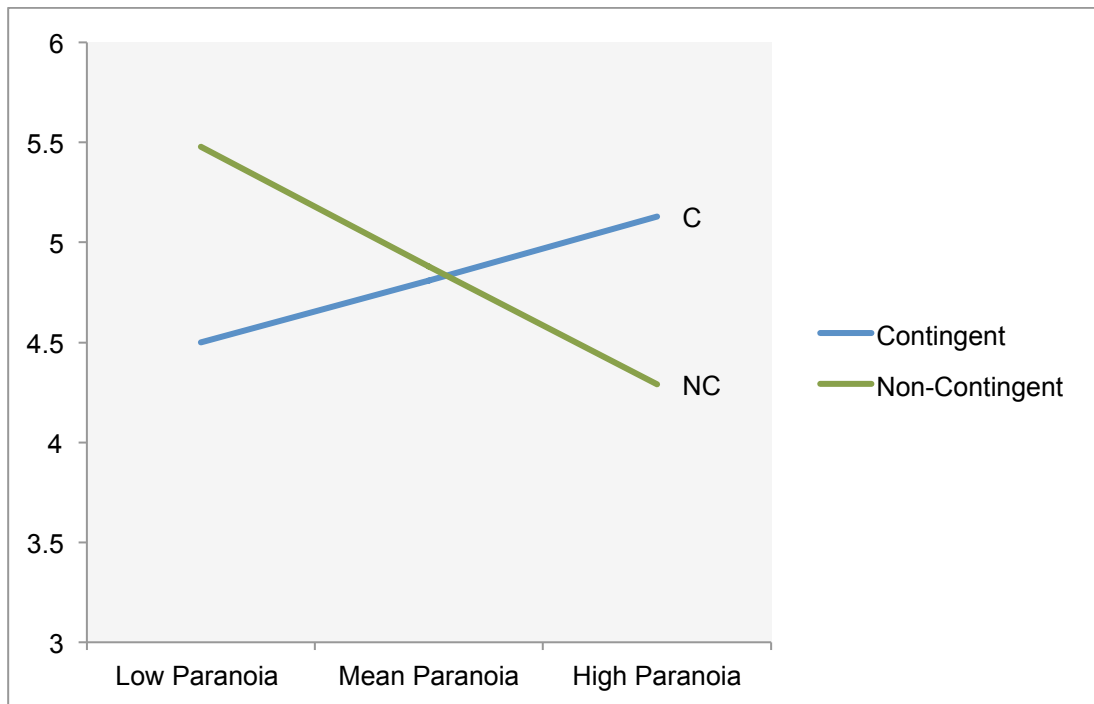


Figure 4. Avatar trustworthiness rating by Paranoia level and Contingency condition.

Table 8. Hierarchical regression analysis for 'explicit trust towards avatar'.

	B	SE (B)	β	<i>t</i>	<i>p</i>	R ²	ΔR^2
Step 1						.10	.10
Trait Anxiety	-0.02	0.02	-0.19	-1.26	.212		
Paranoia	0.03	0.02	0.31	1.63	.109		
Contingency	1.77	0.96	0.84	1.85	.070		
Paranoia*Contingency	-0.05	0.03	-0.95	-2.03	.047*		
Step 2						.34	.24
Trait Anxiety	-0.03	0.02	-0.22	-1.27	.211		
Paranoia	0.03	0.02	0.30	1.55	.127		
Contingency	3.08	0.97	1.46	3.19	.003**		
Paranoia*Contingency	-0.09	0.03	-1.54	-3.24	.002**		
Baseline negative affect	0.13	0.05	0.32	2.56	.014*		
Overattribution of contingency	0.13	0.31	0.05	0.43	.669		
Secure attachment	0.03	0.11	0.04	0.25	.802		
Fearful attachment	-0.03	0.08	-0.05	-0.32	.748		
Preoccupied attachment	0.13	0.08	0.22	1.57	.122		
Dismissive attachment	0.26	0.09	0.40	2.84	.007**		

Note: * $p < .05$; ** $p < .01$, *** $p < .001$

3.7.2 Predictors of implicit trust

It was hypothesised that implicit trust, as indicated by the distance participants kept from the avatar after he had invited them to come and have a look at the terrace, would also be predicted by an interaction between paranoid ideation and contingency condition, insecure attachment, a tendency to overattribute contingency and high negative affect at the start of the encounter.

In the final model (step 2, see Table 9), mean baseline distance and dismissive attachment were significant predictors of implicit trust. The model explained 36% of the variance, and was significant ($R^2 = .36$, $F(11,48) = 2.47$, $p = .015$). The finding of a significant effect of dismissive attachment is in line with a hypothesised role of insecure attachment. Participants with higher ratings of dismissive attachment kept a greater distance from the avatar. In contrast to what had been hypothesised, the interaction between paranoia and contingency failed to reach significance as a predictor of implicit trust. Similarly, negative affect or a tendency to overattribute contingency did not significantly predict implicit trust.

Table 9. Hierarchical regression analysis for 'implicit trust' (distance kept from avatar).

	B	SE (B)	β	<i>t</i>	<i>p</i>	R ²	ΔR^2
Step 1						.19	.19
Trait Anxiety	0.00	0.00	0.03	0.19	.851		
Baseline (mean) distance	0.29	0.12	0.31	2.43	.018*		
Paranoia	0.00	0.00	0.12	0.67	.506		
Contingency	-0.21	0.22	-0.41	-0.93	.355		
Paranoia*Contingency	0.01	0.01	0.59	1.32	.193		
Step 2						.36	.17
Trait Anxiety	0.01	0.01	0.26	1.56	.125		
Baseline distance	0.30	0.12	0.32	2.56	.014*		
Paranoia	-0.00	0.01	-0.02	-0.13	.898		
Contingency	-0.29	0.23	-0.57	-1.25	.219		
Paranoia*Contingency	0.01	0.01	0.83	1.77	.083		
Baseline negative affect	-0.01	0.01	-0.13	-1.02	.311		
Overattribution of contingency	0.12	0.01	0.20	1.66	.103		
Secure attachment	0.04	0.03	0.23	1.42	.164		
Fearful attachment	0.01	0.02	0.09	0.65	.517		
Preoccupied attachment	-0.03	0.02	-0.19	-1.38	.175		
Dismissive attachment	0.05	0.02	0.31	2.18	.035*		

Note: * $p < .05$; ** $p < .01$, *** $p < .001$

3.7.3 Predictors of perceived avatar empathy

It was expected that perceived avatar empathy would also be predicted by an interaction between paranoid ideation and contingency condition, insecure attachment, a tendency to overattribute contingency and high negative affect at the start of the interaction.

In the final model (step 2, see Table 10), dismissive attachment was a significant predictor of perceived empathy. Contingency condition also emerged as a significant predictor; however this effect cannot be interpreted as a main effect given the presence of the interaction term in the same model (Hayes, Glynn & Huge, 2011). The effect was in the opposite direction to what had been hypothesised. Participants with higher dismissive attachment ratings perceived the avatar as more empathic. However, whilst the overall model explained 30% of the variance in perceived empathy, it was not significant ($R^2 = .30$, $F(10,44) = 1.90$, $p = .071$). In contrast to the hypothesis, whilst approaching significance, the interaction between paranoia and contingency did not significantly predict perceived empathy ($p = .054$). Baseline negative affect and a tendency to overattribute contingency also did not significantly predict perceived avatar empathy.

Table 10. Hierarchical regression analysis for 'perceived avatar empathy'.

	B	SE (B)	β	<i>t</i>	<i>p</i>	R ²	ΔR^2
Step 1						.12	.12
Trait Anxiety	-0.20	0.15	-0.21	-1.31	.195		
Paranoia	0.12	0.17	0.31	0.14	.713		
Contingency	16.35	8.51	0.92	1.92	.060		
Paranoia*Contingency	-0.35	0.23	-0.75	-1.52	.136		
Step 2						.30	.18
Trait Anxiety	-0.19	0.18	-0.19	-1.05	.302		
Paranoia	0.14	0.18	0.16	0.78	.442		
Contingency	23.57	9.13	1.32	2.58	.013*		
Paranoia*Contingency	-0.49	0.25	-1.05	-1.98	.054		
Baseline negative affect	0.25	0.46	0.07	0.55	.585		
Overattribution of contingency	-1.60	2.71	-0.08	-0.59	.558		
Secure attachment	-0.09	0.94	-0.02	-0.09	.927		
Fearful attachment	-0.71	0.74	-0.14	-0.96	.344		
Preoccupied attachment	0.32	0.72	0.07	0.45	.658		
Dismissive attachment	2.19	0.83	0.40	2.63	.012*		

Note: * $p < .05$; ** $p < .01$, *** $p < .001$

4. Discussion

4.1 Summary of findings

The present study examined the impact of positive interpersonal contingency on the experience of trust towards and perceived empathy of unfamiliar others in individuals across a range of trait paranoia. The study also further explored hypothesised associations between the experience of trust and perceived empathy and other factors that have been associated with persecutory ideation, including insecure attachment (e.g. Pickering et al., 2008), a tendency to overattribute contingency (Blakemore et al., 2003), and anxiety (Freeman et al., 2002; 2010). This was the first study to investigate the role of contingency across the paranoia continuum in human interpersonal interactions.

The results show that interpersonal contingency influences the experience of explicit trust, and that the direction of this influence is moderated by the severity of trait paranoia. No support was found for the original hypothesis that individuals high in paranoia would report similar levels of trust towards the avatar regardless of the level of contingency displayed by the avatar whereas those low in paranoia would experience the contingent avatar as more trustworthy. In contrast, evidence was found for an interaction between paranoia and contingency in the opposite direction. Participants high in paranoia reported a greater level of trust towards a contingent avatar than a non-contingent avatar, whereas those low in paranoia did not experience the contingent avatar as more trustworthy. When other variables were taken into account, participants low in paranoia in fact experienced the non-contingent avatar as more trustworthy than the contingent avatar.

However, these differences were found not to extend to an implicit measure of trust (the distance participants kept from the avatar) or participants' perception of avatar empathy, which did not differ as a function of contingency at different levels of paranoia.

The only type of insecure attachment that, as hypothesised, significantly predicted reduced implicit trust as assessed by distance kept from the avatar was dismissive-avoidant attachment, which was found to have the opposite effect on the other two dependent variables, predicting higher explicit trust and perceived empathy.

4.1.1 Explicit trust

The virtual scenario was designed to be an experience of an overall friendly and positive interaction. This was also evidenced by an overall reduction in negative affect across participants following the scenario. It is therefore perhaps unsurprising that baseline levels of self-reported trust toward the avatar were relatively high, with no evidence of extreme overt mistrust of the avatar in any of the groups. However, despite this baseline level of trust, group differences were found.

The pattern of interaction between paranoia and contingency in influencing perception of avatar trustworthiness was unexpected as it was predicted that individuals high in paranoia would not be sensitive to the effect of positive interpersonal contingency, whereas those low in paranoia would be. The findings show that participants high in paranoia did experience the two contingency conditions differently, and suggest that participants at the high end of the paranoia continuum may in fact be more sensitive to positive effects of interpersonal contingency on trust. It may be that, due to a default threat-based focus in social interactions that may be the result of a lack of safeness experienced in early attachment interactions (MacBeth et al., 2008) a particularly high level of interpersonal contingency provides the sensitive environment that is required for those high in paranoia to develop trust in encounters with unfamiliar others, and that within a non-threatening context, this level of contingency is experienced positively.

Attributional biases such as a personalising bias have been proposed to occur when there is a perceived threat to self (Bentall et al., 2001). Paranoid ideation has been shown to increase under conditions of stress and increased state anxiety (e.g. Lincoln, Lange, Burau, Exner & Moritz, 2010; Lincoln, Peter, Schäfer & Moritz, 2009), with initial evidence of mediation by reasoning biases such as jumping to conclusions (e.g. Lincoln, Lange, et al., 2010). The current scenario was not designed to be ambiguous or threat-oriented and therefore the above mentioned social cognitive biases that result in a tendency to infer negative intentionality might have not been activated because state anxiety was not raised. Paranoia research to date has predominately focused on the presence of negative attribution biases, but there is a emerging research suggesting that such a personalising bias may also apply to positive events (Lincoln, Mehl, Exner, Lindenmeyer, & Rief, 2010). Similarly, mentalising (Theory of Mind) deficits that have been implicated in persecutory delusions (e.g. Harrington, Langdon, Siegert & McClure, 2005) may not become prominent in social interactions unless negative affect is raised. Either way, the findings suggest that for individuals high in paranoia, interpersonal contingency can be a positive, non-aversive experience that does not immediately lead them to infer negative intentionality.

With regards to the role of contingency for those low in paranoia, the pattern of interaction found differed depending on whether paranoia was examined as a dichotomous variable or whether the full sample and all scores along the paranoia continuum were included in a regression analysis. The regression analysis included a spectrum of paranoia scores along the continuum. This analysis may therefore have been more sensitive to picking up a negative effect of contingency on trust across the paranoia continuum than the dichotomous analysis, which included a smaller number of participants at the extremes of paranoia. Additionally, the interaction effect found in the regression analysis was present within the context of a model which included other variables, such as trait anxiety, dismissive attachment

and baseline negative affect. It may therefore be that the interaction effect in the lower paranoia range is expressed only when the influence of these other variables is taken into account.

A tentative explanation for the contrasting preference of individuals at the lower end of the paranoia continuum to experience the non-contingent avatar as more trustworthy, is that they may have a preference for a lower level of interpersonal contingency in encounters to the one portrayed in the current 'contingent' scenario. In both conditions, the avatar was programmed through head tracking to follow the participant's gaze. Slater (2009) describes the impact of avatar eye gaze to the participant as an example of a variable that increases a participant's illusion that the events in the scenario are actually occurring. Furthermore, the avatar's verbal responses can be considered to be contingent in both conditions. In addition, whilst this is not a contingent behaviour, the virtual flatmate was animated in his general body language throughout the scenario. It may be that the non-contingent virtual flatmate actually met the implicit preferred level of responsiveness for those low in paranoia, and perhaps the additional level of contingency displayed by the contingent avatar may have violated expected norms, negatively affecting trust in this group. This is in line with the minor but statistically significant reduction in positive affect in the low paranoia group after the interaction with the virtual avatar. Additionally, although individuals in the low paranoia group were no more likely to have 'noticed' the avatar contingent behaviour than the high paranoia group, the sample as a whole were more likely to have detected 'a contingent relationship' with the avatar in the contingent than in the non-contingent condition as identified through the post-VR checks. This means that about one third (3/9) of low paranoia participants in the contingent condition might have become aware of the contingent behavior of the avatar which could have had a potentially adverse influence on their judgement of the avatar, given data from

mimicry research showing that conscious detection of mimicry can negatively affect appraisal of the other (Bailenson, Yee, Patel & Beall, 2007).

The current findings extend previous research on the role of interpersonal mimicry (Bailenson & Yee, 2007) and confirm that interpersonal contingency, as a concept related to but different from mimicry, also affects appraisal of the other in interactions. In addition, whereas previous studies have focused on variables such as likeability (Vrijnsen, Lange, Dotsch et al., 2010) and persuasiveness (Bailenson & Yee, 2005), the current results provide initial evidence for the notion that specific responsiveness - in this case, contingency - can influence the experience of trust. However, the current findings depart from previous research on social anxiety, where positive effect of mimicry was evident in the non-socially anxious group, yet socially anxious individuals did not experience this increase (Vrijnsen, Lange, Dotsch et al., 2010). Self-focused attention, which is associated with social anxiety (e.g. Schulz, Alpers & Hofmann, 2008) was offered by the authors as a possible explanation for this finding. The current findings suggest that different processes may have played a role for individuals high in paranoia.

Other than differences between social anxiety and paranoia, the difference in findings may also highlight differences in the outcome constructs investigated. Explicit trust is a different concept from other person appraisals previously investigated in mimicry research. Whereas likeability or persuasiveness can be conceptualised as avatar attributes, trustworthiness relates to trust, which has been argued to be a complex interpersonal construct (e.g. Pearce, 1974). Development of trust is a process that may usually need time and experience of the other, and pathways to first impressions of trustworthiness may therefore differ from more superficial appraisals. Trustworthiness judgements may rely more on internal models of the 'other' influenced by the nature of early attachment experiences with caregivers (Mikulincer, 1998). In addition, previous research has employed very different scenarios that did not involve actual interactions, such as passive listening

to an avatar giving a speech (Vrijssen, Lange, Dotsch et al., 2010), making direct comparison more difficult.

4.1.2 Implicit trust

The finding that avatar contingency did not interact with paranoia to affect the distance participants kept from the avatar when he had invited them to look at the terrace, suggests that in the current scenario, participants' subjective sense of trust was not expressed at this objective behavioural level. Alternatively, it could be argued that the distance participant kept from the avatar was not an accurate indicator of implicit trust. A number of participants had commented on having accidentally walked 'into' the wall due to the realistic 3D image of the flat. It is possible that this may have made some participants more cautious about their positioning within the flat. Distance kept from the avatar has been characterised in past virtual reality research as an indicator of avoidance (Rinck et al., 2010). When conceptualising distance in this way, the findings could be interpreted as a lack of specific patterns of avoidance when comparing groups. However, the finding that negative affect at baseline did not predict the interpersonal distance, suggests that distance was perhaps not driven by anxiety. As avoidance in this way is generally regarded as a safety behaviour in context of anxiety (e.g. social anxiety, see Bögels & Mansell, 2004) and persecutory delusions (Freeman et al., 2002), the lack of difference in avoidance in the current study may be a result of the general pleasant nature of the scenario. It is possible that differences in distance, whether conceptualised as a behavioural expression of trust or anxiety-related avoidance, only become prominent in more ambiguous or threat-focused scenarios.

4.1.3 Perceived empathy

Findings of an effect of contingency at different levels of paranoia did not extend to perceived empathy, whether paranoia was considered as a dichotomous or a continuous variable. Perceived empathy was considered to be a concept that relates to trust, and trust and perceived empathy were indeed found to be correlated. The finding of a near significant interaction effect suggest that the two concepts may have commonalities but are also associated with different pathways. The single question about avatar trustworthiness may have allowed participants to tap into a 'gut feeling' about their feelings towards him. This may have been particularly relevant for individuals high in paranoia, who have been shown to use more experiential reasoning than rational reasoning, showing a preference for relying on their intuition more (Freeman, Evans & Lister, 2012). It is possible that a higher degree of mentalising is required for accurate appraisal of perceived empathy. An important difference is that perceived empathy was assessed with a range of comprehensive questions, and some participants did comment on how difficult it was to answer these questions about the avatar's characteristics after such a short interaction (e.g. *'Mark, the virtual flatmate came across as the kind of person who would appreciate exactly how the things I experience feel to me'*).

In addition, facial and emotional mimicry are known to be strongly associated with the experience of empathy (e.g. Decety & Jackson, 2006; Sonnby-Borgström, Jönsson & Svensson, 2003). It is possible that the findings regarding perceived empathy are the result of an absence of facial and emotional mimicry or contingency, which participants may rely on more than interpersonal behavioural contingency for appraisal of perceived empathy.

4.1.4 The role of insecure attachment, negative affect and contingency perception

Examination of the role of negative affect, contingency perception and attachment in the current study was exploratory in nature, and interpretation of the findings is tentative and limited in the absence of follow-up moderation or mediation analyses with paranoia specifically. However, the exploratory regression analyses produced some unexpected findings.

Cognitive models of paranoia (Freeman, et al, 2002) consider emotional factors such as anxiety to be important variables in understanding the development of paranoia. The finding that the experience of a higher level of negative affect prior to entering the virtual scenario predicted an increase in overtly reported trust towards the avatar was therefore unexpected. It may be that this could be explained by the positive nature of the scenario, which may have particularly helped individuals who were feeling very anxious to begin with to develop a sense of trust as they felt reassured during the interaction with the friendly avatar.

The finding of past research that individuals with persecutory delusions (Blakemore et al., 2003) or schizotypy (Fyfe et al., 2008) have a tendency to overattribute contingency between moving shapes, was found not to extend to non-clinical paranoia in the current study. This does not seem to be explained by insufficient power given small sample sizes when comparing groups at the paranoia extremes, as when the full sample was included, a tendency to overattribute contingency was not found to predict trust (whether explicit or implicit) or perceived empathy. The experience of interpersonal contingency in paranoia has not previously been investigated, and perception of such interpersonal contingency is likely to differ from research not involving human interactions. However, whereas no conclusion can be drawn from the current findings that those high in paranoia overattributed contingency in the animated interactions, it can be concluded that they accurately 'perceived' the contingent interaction to be different and this did not result in attributing negative intentionality.

Insecure anxious attachment, which has been associated with paranoia (e.g. Pickering et al., 2008), was notably absent as a predictor of trust, interpersonal distance or perceived empathy. In fact, dismissive attachment was the only type of insecure attachment that was found to play a role in predicting trust and perceived empathy. It predicted an increase in explicit trust and perceived empathy, but also a reduction in implicit trust as measured by a larger distance kept from the avatar. A dismissive attachment style is characterised by avoidance of emotionally close relationships, a positive self-image and a negative view of others (Bartholomew & Horowitz, 1991). Bartholomew (1990) described that dismissively attached individuals may have come to expect rejection when showing emotional vulnerability. Whilst a role of avoidant attachment is in line with existing research on associations between avoidant attachment and paranoia (Berry et al., 2008), the increase in self-reported trust and perceived empathy with greater dismissive attachment was opposite to what was expected. Recent research may shed light on this apparent unexpected finding. Despite their apparent reported disinterest in emotionally close relationships, individuals with dismissive attachment have in fact been found to care about interpersonal relationships and being accepted by others (Carvallo & Gabriel, 2006), and to experience a sense of connection even more strongly than others during positive social interactions (MacDonald & Borsook, 2010). Interestingly, the increase in explicit trust and perceived empathy with greater dismissive attachment was contradicted by the finding that having a dismissive attachment style also predicted participants' decision to stand further away from the avatar. This discrepancy may suggest some internal conflict for those with dismissive attachment. Despite a need to belong (MacDonald & Borsook, 2010) and experiencing feelings of increased trust and perceived empathy in the context of a positive social interaction, dismissively attached participants may have experienced some internal conflict in relation to proximity seeking based on possible

early attachment experiences, which may explain why they maintained greater distance.

4.2 Limitations

The current findings need to be interpreted in the context of some limitations. Firstly, the sample size was modest and whilst it allowed for investigation of paranoia on a continuum, it was clearly limited in that it included only a small number of participants with paranoia scores at the high extreme of the spectrum, falling short of the required sample size as indicated by the power analysis. This distribution of scores may have resulted in missed effects that may only show in samples at the extremes of the paranoia continuum. In addition, as the virtual flatmate was male, a male participant sample had purposely been selected, and findings cannot be generalised to a female population. As mentioned previously, regression analyses of the role of other variables were exploratory in nature only. Future research could investigate mediation and moderation relationships between relevant variables. It is also important to note that a substantial number of analyses were conducted as part of the study, and the possibility of Type I errors cannot be excluded. It was beyond the scope of the current study to conduct log analyses of the avatar's movements³. Further research needs to assess whether the method of a twenty-second delay in the non-contingent condition is a suitable method through close inspection of computerised logs of movement, and needs to consider the actual amount of contingency elicited in the interaction. Additionally, it will be interesting to investigate the role of participants' own movements during the encounter.

A notable limitation is that in the absence of an appropriate standardised self-report measure of trust, avatar trustworthiness was measured with a single

³ Log files contain a record of participants' movements and all avatar responses elicited during the 2.5 minutes.

Likert scale question. This question had the advantage of clarity and simplicity, and may have tapped into participants' gut feeling, without having to overthink the appraisal. However, it is clearly not a refined measure of trust and it would be preferable for a more appropriate measure to be developed and validated for the purpose of measuring trust towards virtual characters.

Examining the role of contingency in a virtual setting provided both a unique opportunity for careful and consistent manipulation of avatar contingency, but also posed challenges which may have affected the study findings. The avatar displayed a baseline animation (e.g. arm gestures), which may to some extent have introduced 'noise' and may have overshadowed more subtle avatar contingent movements (e.g. nodding and body sways) and may also have increased the positive experience of the scenario. In addition, there was consistent avatar gaze in response to movements of the participant's head tracker. A final limitation in this respect, is that the experimental manipulation of contingency in the current study was that of non-verbal responsiveness only. The importance of verbal content and responsiveness in the development of trust between individuals cannot be underestimated. The virtual flatmate's responses were generally very responsive (i.e. the avatar responded every time the participant asked a question), and as such highly contingent on a verbal level. Together with the avatar's gaze, this may have created a baseline level of experienced contingency in both conditions. This may have affected the study's power to find effects based purely on non-verbal responsiveness such as past VR mimicry studies (e.g. Vrijssen, Lange, Dotsch et al., 2010).

4.3 Implications for future research and clinical practice

Previous virtual reality research has been fruitful in examining cognitive and emotional factors in paranoia (e.g. Freeman et al., 2003, 2008, 2010; Freeman,

Garety, Bebbington, Slater, et al., 2005). The current study has extended past research to examine the experience of individuals across the paranoia continuum in actual interpersonal interactions within a virtual reality setting, and to further elucidate interpersonal processes in paranoia.

The current findings raise some questions about the role of the actual scenario and the friendly nature of the interaction, and whether the findings may have been different had the scenario been a more ambiguous or negative experience. Participants high in paranoia actually did seem to be very sensitive to the effects of contingency, and whilst this had a positive impact in the current pleasant scenario, such sensitivity to contingency may have negative implications in situations where individuals may be primed to be threat focused. For example, such an effect of environment was demonstrated in the Camberwell walk study (Ellett, Freeman & Garety, 2008), where being in an urban environment with high deprivation and crime significantly increased paranoia and associated negative affect and reasoning biases in those with persecutory delusions.

Whilst the current scenario included an 'ambiguous' phone call which could have been interpreted negatively, future virtual scenarios could explore the role of interpersonal contingency in a more clearly ambiguous or even negative scenario. This would also allow for further exploration of whether interpersonal distance is affected differently in such scenarios and whether this relates in those scenarios to experience of trust, affective processes, or both. Replication of the current study with a clinical population would establish whether results may be different for those with persecutory delusions, even in a pleasant scenario. This is particularly relevant in light of findings that some reasoning biases associated with persecutory delusions may not always be found in non-clinical populations (e.g. McKay et al. 2005).

Self-focused attention has been proposed as a potential maintaining mechanism in anxiety disorders (see review Bögels & Mansell, 2004). The current

finding that trust of individuals high in paranoia was affected differently in the two contingency conditions, suggests that those participants ‘experienced’ the contingency and that their attention was actually focused externally. Virtual reality research could in the future explore the relative role of hypervigilance compared to self-focused attention in paranoia. Again, using scenarios that elicit a wider range of affect may help clarify whether self-focused attention does become prominent in threat-focused situations. Similarly, virtual reality research can be a powerful tool for more detailed investigations of interpersonal behaviours in paranoia, such as safety behaviours other than interpersonal distance. The role of negative affect may also be more accurately investigated through ‘live’ physiological measurements during virtual interactions.

The current findings suggest that when working clinically with individuals high in trait paranoia, awareness of interpersonal contingency may be particularly important, as careful attunement to the client and contingent responsiveness in the therapeutic setting might be crucial for the development of a trusting therapeutic relationship. In addition, the finding that those with higher baseline negative affect trusted the avatar more, which may have been due to the pleasant and reassuring nature of the scenario, suggests that the development of trust towards unfamiliar individuals high in state anxiety may be particularly sensitive to situational factors, and this should be taken into consideration in therapeutic work. Furthermore, the current results have implications for clinical case formulation and therapeutic intervention with individuals with a dismissive attachment style, indicating that whereas such individuals may report a disinterest in close emotional relationships, for them the development of trust in unfamiliar others also appears to be sensitive to positive social interactions. At the same time, it may be important to be aware that dismissively attached individuals may still experience some proximity seeking conflict.

Finally, the impact of interpersonal contingency does not limit itself to how this is experienced when being at the receiving end of such responsiveness. Indeed, mimicry research suggests that interpersonal mimicry is generally a fluid process whereby both conversational partners unconsciously mimic the other. Therefore, as has been suggested in relation to mimicry (Van Baaren et al., 2009), not reciprocating interpersonal contingency may be unexpected and may have negative effects on the ability to sustain positive interactions with others (Vrijnsen, Lange, Becker & Rinck, 2010). Vrijnsen, Lange, Becker and Rinck's (2010) research with a non-clinical population suggests that there may be a lack of such interpersonal mimicry in individuals with social anxiety. It will be interesting to investigate whether those at the higher end of the paranoia continuum themselves engage in interpersonal contingency or mimicry.

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Part 3: Critical Appraisal

1. Introduction

This appraisal will review two areas that have been key to the research process, and include personal reflections on this process. Firstly, it will consider the challenges experienced in recruiting participants representing the full spectrum of the paranoia continuum, and implications of this for the design of the research. It will then discuss the use of virtual reality research in investigating interpersonal encounters, including the contribution of the current study in relation to existing research in the area of paranoia. Challenges associated with the use of virtual reality technology in investigations of interpersonal encounters are also considered.

2. Recruitment across the paranoia continuum

Whilst the current empirical research did not involve recruitment of a clinical population, it nonetheless relied in part on recruitment of participants with high trait paranoia in the general population via an online route, which proved a challenge in the limited time available. Difficulties in recruitment of individuals with persecutory delusions have been acknowledged in the literature (Freeman, 2007), and similar challenges are likely to arise in non-clinical populations with high trait paranoia as shared features of suspicion, avoidance and anxiety (Freeman et al., 2002) can prevent some individuals from taking part. Being a two-phase study further compounded this, as inevitably a proportion of the initial sample did not take up the invitation to participate in the virtual reality phase of the study. In addition, in order to have the opportunity to review participants' interactions with the avatar following their time in the virtual environment to aid data interpretation where this would be helpful, videorecording⁴ of the virtual encounters had been planned and brief information about this was incorporated in the participant consent form. In

⁴ Video- recording had been planned at the initial stages of the study but this was not implemented in the current study.

hindsight, this may have been a further barrier to recruitment of participants at the extreme end of the paranoia continuum.

In common with many general population studies, a history of mental health difficulties was an exclusion criterion for participation. Of all participants that accessed the initial online questionnaire in the first phase of recruitment, nearly 25% had to be excluded on these grounds. The actual percentage of participants with a history of mental health problems may have even been higher when considering that such experiences may have been underreported in the online survey. Experience of paranoia is associated with emotional concerns including anxiety and depression (e.g. Freeman, Dunn, et al., 2005). Perhaps unsurprisingly, from inspection of participants' responses it was clear that excluding participants with current or past experience of mental health problems often excluded the very participants with higher trait paranoia scores that were most difficult to recruit. Whereas there was a clear rationale for exclusion of participants with acute experience of psychosis as assessed by the Psychosis Screening Questionnaire (Bebbington & Nayani, 1995), in hindsight, the broader mental health exclusion criteria applied raises the question of whether this was necessary, and implications for the external validity of studies with healthy volunteers given the population prevalence of mental health difficulties such as anxiety and depression. In future research, I would carefully consider whether perhaps only current experience of mental ill health should be an exclusion criterion.

At the outset of the project, the aim had been to only select participants high or low in paranoia, resulting in a 'pure' 2x2 research design. However, as a result of time constraints⁵ and the expected slower rate of recruitment of eligible participants with particularly high paranoia scores given their lower prevalence in the general

⁵ Recruitment was limited to a one-month period only. This is because the virtual scenario required the use of software of which the licence had expired early in the year. Given the prohibiting high costs of renewal, the Computing Department decided not to buy a new licence. An exclusive extension was granted by a software company for the sole use of the software for the current project in May 2013 for one month.

population (Freeman, 2007; Freeman, Garety, Bebbington, Smith, et al., 2005), the design of the study had to be modified with a change in the recruitment strategy to invite all eligible participants across the paranoia continuum. A total sample size of $n=70$ participants (which would have resulted in two groups of about 35 high and 35 low paranoia) would have been required to achieve a power of 0.80 using a factorial ANOVA for data analysis. As participants were planned to be selected on the basis of low (bottom 20%) or high (top 20%) scores on a measure of trait paranoia, 200 participants would have been needed to complete the pre-selection assessment questionnaires and to be eligible to be approached for the virtual reality phase. Instead, even though 281 participants completed online questionnaires in the initial online recruitment stage, after exclusion criteria were applied there were only 63 participants who were eligible and able to attend phase two. As mentioned above, all of them were invited to complete the study. When the top and bottom 20% were selected for the dichotomous analyses, this resulted in high and low paranoia groups of $n=18$ and $n=12$.

However, this change in the approach to recruitment provided an opportunity to examine the impact of interpersonal contingency on trust across the paranoia continuum. From a continuum perspective, I feel this has been a relevant and meaningful addition to the study and research area, as the impact of the study variables across the paranoia continuum could meaningfully be investigated⁶ through the regression analyses, which provided relevant additional findings and helped identify that there was also an interaction effect between paranoia and avatar contingency in predicting explicit trust at the low end of the paranoia continuum in addition to the interaction effect that had been identified at the high end of the paranoia continuum through the dichotomous analyses. This regression finding also indicated that in both contingency conditions, the avatar trustworthiness

⁶ Findings of the regression analyses were in the context of a full regression model including all relevant independent variables.

ratings of individuals with a mean trait paranoia score fell between those at the high and low end, in line with a continuum view.

Conducting research with a population varying in levels of trait paranoia has increased my awareness of the potential impact of the research setting and testing procedures on participants' affect state during their participation. It is common in psychological research for participants to complete a range of measures prior to taking part in the experimental part of the research. In the current study, participants also spent time with the researcher in order to complete baseline measures and gain written consent prior to entering the virtual environment. Such interactions may to some extent have put some highly anxious participants at ease. In addition, through unexpected technical difficulties with the virtual reality technology, some participants spent even more time in the presence of the researcher, and I had to contact some participants by phone or email to apologise for a short-notice cancellation and re-arrange appointments. Whilst I was mindful of the potential impact of this on the participants' experience and the latter in particular was a variable outside of my control, this is perhaps a variable that needs even more consideration in psychological research, including research within the general population when recruiting participants who may be prone to feeling anxious.

3. The use of virtual reality in research investigating interpersonal encounters

3.1 Virtual reality technology: Opportunities

From the outset, I felt excited about the opportunity to conduct research in the area of paranoia using virtual reality technology. Despite increasing use of virtual reality technology in paranoia research, this study was the first known to specifically involve an actual interpersonal encounter, involving a one-to-one interaction including a conversation between the participant and the avatar. To date, virtual reality studies investigating paranoia have used virtual scenarios where paranoid

ideation was elicited by immersing the participant in neutral/ambiguous scenarios populated by a number of avatars but not direct interactions with virtual characters. Scenarios used include a virtual London underground train journey (Fornells-Ambrojo, Barker, Swapp, Slater, Antley & Freeman, 2008; Freeman et al., 2008, Freeman, Pugh, Vorontsova, Antley & Slater, 2010; Valmaggia et al., 2007), and a library (Freeman et al., 2003; Freeman, Garety, Bebbington, Slater, et al., 2005). In both scenarios multiple virtual characters were present, and interactions were limited to some behaviours such as looking or smiling in the direction of the participant.

Whilst these scenarios are highly relevant and likely have external validity as they reflect everyday situations likely to be experienced by many individuals, the opportunity to study interpersonal processes within these scenarios is limited, as participants do not engage directly with the avatars. Given that paranoia is per definition an interpersonal concern, the opportunity to develop a new scenario that allowed investigation of actual interpersonal interactions felt like an important advance of the research area, in particular in comparison with social anxiety research, where one-to-one encounters with a single virtual character have started to be explored (e.g. Vrijzen, Lange, Becker & Rinck, 2010; Vrijzen, Lange, Dotsch, Wigboldus, & Rinck, 2010). In particular, a study by Pan, Gillies, Barker, Clark and Slater (2012) is an example of a study that involved an actual interaction with an avatar where 'socially anxious' and 'socially confident' male participants were approached by a female avatar who engaged them in conversation, in a virtual scenario depicting a party.

Studies using virtual reality have made important methodological advances by incorporating objective measures such as participants' physiological responses, instead of relying solely on subjective self-report measures. For example, the above study by Pan et al. (2012) made use of ECG and skin conductance measures to directly measure anxiety responses. The experience of anxiety is an important

factor in paranoia (Freeman et al., 2002), and whilst incorporation of physiological measures was beyond the scope of the current study, such physiological measures will be a valuable contribution to future paranoia research. Of additional relevance to the current research study, Pan, Gillies and Slater (2008) studied participants' responses during a conversation with an avatar and found meaningful associations between objective measurements of socially anxious participants' body movements and relevant VR situational and person-variables. This demonstrates the potential for paranoia research to benefit from such measurement of body movements to study the impact of situational and person factors on an individual's own body movements. As mentioned previously, this could include participants' own use of contingent behaviour in social interactions. The current study included an objective measure of trust (distance kept), and findings of discrepancy between the two outcomes highlight differences between implicit and explicit processes that would be worth considering in future investigations.

The focus of the current study on investigating trust of individuals with varying levels of trait paranoia within a positive interpersonal framework, also appealed to me from the start. I feel that this different focus on positive interpersonal interactions has been a further contribution to the research area, as paranoia research to date has predominately focussed on elucidating factors associated with experience of mistrust and the research often considers negative factors that are expected to trigger paranoia. The role of positive interpersonal encounters is under researched yet can be considered to be equally relevant if all aspects of trust development in individuals experiencing paranoia are to be fully understood.

There has been increasing research interest in the role of attachment in psychosis (Read & Gumley, 2008) and paranoia specifically (e.g. Pickering et al., 2008) and in context of these developments, I was enthusiastic about the opportunity to incorporate some preliminary investigations of the role of attachment

in the experience of trust in interpersonal interactions using VR methodology. However, further virtual reality research incorporating mediation and moderation analyses are required in order to specifically examine the relationship between trait paranoia and attachment in social interactions. The findings of the current study in relation to the role of dismissive attachment in predicting increased explicit but reduced implicit trust highlight how such fundamental attachment models laid down early in life can be identified to implicitly play a role in the subjective experience of current interpersonal interactions. The findings of the literature review presented in this thesis suggest that it may be particularly interesting to use VR methodology to assess the impact of emotional abuse on the development of trust in 'live interactions', and whether a relationship would be mediated or moderated by attachment. It is of interest that recent research suggests that an individual's attachment style may impact on their experience of virtual environments, as Wallach, Safir and Almog (2009) found that participants with an avoidant attachment style in particular may experience less sense of presence in virtual scenarios. Future virtual reality research could examine the role sense of presence in relation to any findings of attachment identified.

3.2 Challenges of using virtual reality technology

The unique opportunity for a completely new virtual scenario to be developed for the current study also presented a considerable challenge of designing a scenario that would be suitable for the purposes of the specific research question. In addition, with significant resources going into the programming and development, it was important to consider usability of the scenario for future research studies potentially carried out within different research disciplines.

Working with external collaborators on the development of the scenario, including international collaboration with the University of Barcelona further fuelled my enthusiasm for virtual reality research. At the same time, a significant challenge

throughout the project was the dependency on external parties and expertise for the programming of the scenario and all technical aspects of the study. This was particularly challenging at times considering the multitude of unpredictable technical difficulties that inevitably arose while developing a new and conceptually innovative scenario. In addition, several changes in programmers meant that the programming of the scenario was implemented by three different programmers over the course of the project. Without prior experience of developing a virtual scenario, in particular one involving manipulation of a complex construct such as interpersonal contingency, it was difficult to be realistic about what was achievable in a limited amount of time. I was involved in the development process from the start of the project, which included the following stages as part of an iterative process:

- Designing a scenario for the interpersonal encounter: flatmate interview
- Developing a script for the interaction
- Programming of flat design (technical sub team)
- Motion capture actor playing out flatmate part (technical sub team)
- Contingencies programming: nodding, body sway, head tilt (technical sub team)
- Piloting of the validity and acceptability of the contingencies
- Adjustments to contingencies post pilots (technical sub team)
- Contingencies piloting: differences contingent and non-contingent condition
- Adjustments to contingencies post pilot (technical sub team)
- Piloting of flatmate interview using handheld prompts

Developing a suitable scenario was particularly challenging, as the requirements for the current scenario were notably different from those that would have applied to virtual scenarios used in previous paranoia research. It was

important to ensure that no obvious confounds were present that could impact on the findings of the study and limit the conclusions that could be drawn about the effects of the level of interpersonal contingency displayed by the avatar, the central study variable.

In particular, this requirement meant that it was not possible to design a scenario where there was a 'natural' conversation between participant and avatar, as any difference in the verbal content of the interaction might then be attributed to the conversational content rather than interpersonal contingency. At the same time, a more static interaction such as passive listening to an avatar giving a speech (e.g. Vrijssen, Lange, Dotsch et al., 2010) was not considered to be an encounter where participants were truly engaged in a reciprocal interaction. These requirements of developing a scenario that was both controlled as well as engaging enough to feel like an actual interaction, resulted in a compromise whereby participants did truly engage in conversation with the avatar, but the conversation was highly structured through an interview format. The one-sided nature of the conversation (with the participant mainly asking questions) is an obvious limitation with regards to comparing it to real-life conversations. However, for the purposes of testing the role of interpersonal contingency, it was considered a suitable approach that offered a relative high level of control and was most likely to minimise confounds.

A key aspect of the research process was the development of a contingent and a non-contingent condition. An added complication in this respect, was that the avatar's movements are created by mapping of an actor's movements onto the avatar through video capturing. For the development of the scenario, it was key for this to happen as early as possible in the research process. However, once actor movements have been mapped onto the avatar, adjustments to avatar movements are not easily implemented. As a result, it was not possible to reduce the extent of the avatar's animated use of gesture. In future research involving scenarios which

rely on subtle manipulation of avatar movements, careful consideration of this early process of actor motion video capture is recommended.

Further development and piloting can 'fine-tune' the scenario used in the current study and improve on it for future research. In addition to potential refinement of the interpersonal contingency programming should further investigations indicate a need for this, this could involve other additions or changes to the scenario. For example, it was noted by one participant that incorporating some environmental sounds might have increased participants' sense of presence in the virtual flat.

Freeman (2008) notes the power of virtual reality technology to elicit 'real-world' responses which can be used to advance understanding and treatment of psychosis. Despite the challenges and limitations associated with using virtual reality in investigations of interpersonal encounters, the opportunity to conduct the current research has given me first-hand experience of the exciting potential of virtual reality methodology to advance paranoia research. As described, virtual reality methodology offers a number of exciting opportunities to build on the current research and further examine interpersonal processes in paranoia. Future paranoia research employing scenarios of a similar interpersonal nature will likely make highly relevant and important contributions to our understanding of paranoia.

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Appendices

Appendix 1: Study quality checklist

Quality checklist adapted from Kmet et al. (2004).

Appendix 2: Ethical approval

From: '
Subject: **Ethical Approval**
Date: 16 August 2012 11:46:36 GMT+01:00
To:

Dear Miriam,

The CEHP RD Ethics Chair has approved your application.

Researchers: Miriam Fornells-Ambrojo, Maaïke Elenbaas
Number: CEHP/2012/021
Title: Understanding social interactions: an evaluation of a virtual flatmate

Please do make sure that the data you gather are stored anonymously.

Please remember, in general to observe the Code of ethics and conduct. Leicester: The British Psychological Society, March 2006,
and in particular to follow the 'Guidelines for minimum standards of ethical approval in psychological research'.
Leicester: The British Psychological Society, July 2004 when conducting your research.

Yours sincerely,

Essi Viding

CEHP RD Ethics Chair

Appendix 3: Participant Information Sheet

PARTICIPANT INFORMATION SHEET

PROJECT TITLE: UNDERSTANDING SOCIAL INTERACTIONS: AN EVALUATION OF A VIRTUAL FLATMATE

We would like to invite you to take part in a study looking at people's reactions to virtual environments. This project is part of a student research project. Please take time to read the following information carefully and ask us if there is anything that is not clear to you or if you would like more information.

Why have I been invited to take part in the study?

You have been invited to take part in the study because we are looking for healthy male volunteers who are 18 years old or above. In total, we hope that 72 healthy volunteers will take part.

Do I have to take part?

It is up to you to decide whether or not to take part. Choosing not to take part will not disadvantage you in any way. If you do decide to take part you will be given this information sheet to keep, and be asked to sign a consent form. You are still free to withdraw at any time, without giving a reason.

What will happen if I decide to take part?

The project has two phases. Your participation may involve only the first or both of these, as explained below:

Phase 1: Online questionnaires and task

We invite all potential participants to complete some questionnaires which ask about general wellbeing and sensory experiences. At this time you will be asked to complete an online task about the relationships between objects. We will use some of this information to assess suitability to take part in the study and to ensure that there is variability amongst participants. It is possible that you will not be invited to participate beyond this stage.

Phase 2: Virtual reality

If you are invited to participate in the second phase of the study, you will be invited to come to meet with the researcher at UCL, who will accompany you to the virtual reality suite. The main thing you will be asked to do will be to explore a virtual environment. Brief questionnaires will be used to assess how realistic the environment is. In total, this final part of the study will take approximately 30 minutes and includes the following steps:

Part 1 - Questionnaire: Prior to entering the virtual environment you will be asked to complete a brief questionnaire about your feelings at that time.

Part 2 - Virtual Reality: After completion of the questionnaire, we will invite you to enter the virtual reality room representing a student flat. You will be given instructions in the use of virtual reality before you start. You will be asked to wear glasses that produce three-dimensional images and you will be invited to remain in the student flat for a brief time and interact with a virtual flatmate character. There will be another researcher directly outside the virtual suite at all times to ensure that you feel comfortable during the exercise. During your time in the virtual environment your interaction with the virtual flatmate character might be video recorded by an unobtrusive camera in the ceiling to help us review how you and the virtual character move around the room. The video footage will not be shown to anyone outside the research team and will be destroyed when the research project has been completed.

Part 3 – Questionnaires: Following the virtual reality exercise, we will ask you to complete some final questionnaires about your feelings at that time and to provide feedback on the quality of the virtual interaction with a flatmate avatar.

Will I be paid for my participation?

All participants who complete the initial online questionnaires and online task during phase 1 of the study will be entered into a prize draw with the chance to win an Amazon voucher worth £25. In addition, if you are invited and take part in the second phase of the study, you will be paid £10.00 to thank you for your time.

Are there any disadvantages to taking part?

When people use virtual reality systems they occasionally experience a degree of nausea. If at any time you wish to stop taking part in the study due to this or any other reason, please just say so and we will stop.

There has been some research that suggests that people using virtual reality might experience some disturbance in vision afterwards. No long term studies are known to us, but the studies which have conducted testing after about 30 minutes, and have found that the effect is still sometimes there. It is advised that you do not drive a car, motorcycle, or operate complicated machinery in the four hours following virtual reality. There have been various reported side effects of using virtual reality equipment, such as 'flashbacks'. With any type of video equipment there is a possibility that an epileptic episode may be generated. This, for example, has been reported for computer video games. **If you have epilepsy, please tell us. We would not want you to take part in the second phase of the study in this case.** However, you can still take part in the first phase of the study. Your completion of the online questionnaires and online task will be very valuable to the study.

What if there is a problem?

Every care will be taken in the course of this study. However, in the unlikely event that you that something goes wrong and you are injured whilst taking part, UCL has arrangements in place to address this. If you have a concern about any aspect of the study, please ask to speak with the researchers who will do their best to answer your questions.

Will my taking part in the study be kept confidential?

All the information obtained will be kept strictly confidential and you will not be identified. All data will be collected and stored in accordance with the Data Protection Act 1998.

What will happen if I don't want to carry on with the study?

If you withdraw from the study, we will destroy all your identifiable information, but we may use non-identifiable data that we have collected up until your withdrawal.

What will happen to the results of the research study?

The results of the research will be analysed in order to complete a doctorate in clinical psychology and the findings will be published in a scientific journal and may be presented at conferences. You will not be identified in any report or publication. Please inform Maaïke Elenbaas if you would like a copy of the study's findings.

Who is organising this study?

The research is being organised and funded by UCL.

Who has reviewed the study?

The study has been reviewed and has been given ethical approval by the Ethics Chair of the Division of Psychology and Language Sciences (Number: CEHP/2012/021).

Thank you for considering taking part and taking the time to read this information sheet.

Research Team Members:

Maaïke Elenbaas, Trainee Clinical Psychologist, Department of Clinical, Educational and Health Psychology, University College London. Telephone: Email:

Dr Miriam Fornells-Ambrojo, Lecturer in Clinical Psychology, Department of Clinical, Educational and Health Psychology, University College London. Email:

Appendix 4: Participant Consent Form

Consent Form

Version 2: 27.03.13

THIS STUDY HAS BEEN APPROVED BY THE ETHICS CHAIR OF THE DIVISION OF
PSYCHOLOGY AND LANGUAGE SCIENCES (Project ID Number): CEHP/2012/021).

Participant Identification Number:

Date:

CONSENT FORM

PROJECT TITLE: UNDERSTANDING SOCIAL INTERACTIONS: AN EVALUATION OF A VIRTUAL FLATMATE

Name of Researcher: Maaïke Elenbaas

Thank you for your interest in taking part in this research. If you have any questions arising from the Information Sheet or explanation already given to you, please ask the researcher before you decide whether to take part. You will be given a copy of this Consent Form to keep and refer to at any time.

Please initial box

1. I confirm that I have read and understand the information sheet dated 27.03.2013 (Version 2) for the above study. I have had the opportunity to ask questions and have had these answered satisfactorily.
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without any negative consequences.
3. I understand that if I decide to withdraw from the study, any identifiable data collected up to this point will be destroyed but non-identifiable data may be used for the research.
4. I understand that I must not take part in the second phase of the study (the virtual reality stage) if I have epilepsy.
5. I understand that a video recording will be made of my time in the virtual environment. I understand that this video footage will not be shown to anyone outside the research team and will be destroyed upon completion of the project.
6. I understand that the information I have submitted will be published as a report and I will be sent a copy if I request this. Confidentiality and anonymity will be maintained and it will not be possible to identify me from any publications.
7. I consent to the processing of my personal information for the purposes of this research study. I understand that such information will be treated as strictly confidential and handled in accordance with the provisions of the Data Protection Act 1998.
8. I agree that the research project named above has been explained to me to my satisfaction and I agree to take part in this study.

☐☐☐☐☐☐☐☐

Consent Form

Version 2: 27.03.13

THIS STUDY HAS BEEN APPROVED BY THE ETHICS CHAIR OF THE DIVISION OF
PSYCHOLOGY AND LANGUAGE SCIENCES (Project ID Number): CEHP/2012/021).

Please turn over page

_____ Name of Participant	_____ Date	_____ Signature
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_____ Name of Person taking consent (if different from researcher)	_____ Date	_____ Signature
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_____ Researcher	_____ Date	_____ Signature
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When completed: 1 for participant and 1 for researcher

Appendix 5: Question prompts for participants

1. WHAT YOU LIKE ABOUT FLAT SHARING?

2. HOW DO YOU CHOOSE FLATMATES?

3. WHAT MAKES A GOOD FLATMATE?

4. BEST THING ABOUT THIS FLAT

Appendix 6: Virtual scenario script

A=Avatar
P=Participant

A: Hi my name is Mark thanks for coming. What's your name?"

P: (Tells avatar their name)

A: Thanks, OK I'm ready!

P: What do you like about flat sharing?

A: I enjoy meeting new people... I have made new friends this way...its great getting to know them, have a laugh... mhm... and it helps to keep the cost of living low so you can live in a better area!

P: What do you ask potential flatmates before going ahead?

A: Well, I always meet them in person and get a sense of what they are like... I ask them what they are looking for in a shared flat, what is a typical day like for them, what music they like, if they smoke, if they are lazy about house chores... mhm.. If they like having friends around ... Oh, yeah it is also good to ask them what has been their best and worse experience of flat sharing!

P: In your experience... who makes a great flatmate?

A: Mhm... good question... don't know... I'm trying to thinksomeone how is easygoing, friendly and fun but who also can give you space... It is also good to have something in common with them, like love for sport, or music...It's hard to answer because I think it really depends on the person... I've got on with people who were completely different from me, sometimes it just works.

P: What is the best thing about your flat?

A: The terrace and the view! Come and have a look! (moves to the window)

A: It's amazing to have all this outside space, in the summer we practically live outside! We have great BBQs....

(Phone rings – avatar answers and speaks discreetly on the phone)

A: Hello? Okay..yeah I can be there...okay bye.

A: Oh, sorry but I need to go now... anyway thank you for coming and maybe we can continue the interview some other time?

P: (Answers)

SCENARIO ENDS

Appendix 7: Relationship Questionnaire (Bartholomew & Horowitz, 1991)

Appendix 8: Animation Task sample stimulus (Blakemore et al., 2003)

Appendix 9: Perceived avatar empathy

**(Modified version of the Empathic Understanding subscale,
Barrett-Lennard Relationship Inventory; Barrett-Lennard,
1987)**

Appendix 10: Scenario feedback and checks

1. In your experience of your interaction with the virtual flatmate, was there any relationship between what you did and the virtual flatmate's actions? Please circle.

YES

NO

2. If you experienced any relationship between what you did and the virtual flatmate's actions, what did you notice? Please write your comments in the space below.

Please circle whether the following statements are true or false.

1. One reason that Mark the virtual flatmate gave for why he likes flat sharing, is that he has made new friends this way.

TRUE

FALSE

2. When asked who makes a good flatmate, Mark mentioned that the most important thing is that they are tidy.

TRUE

FALSE

Qualitative comments

What did you think of Mark the virtual flatmate?

Appendix 11: Sense of Presence Questionnaire (Slater et al., 1998)

